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COOPER HEWITT INTERRUPTER.

The latest result of Mr. Peter Cooper Hewitt's studies of the mercury vapor tube is described elsewhere in this issue. If a long list of present day desiderata were drawn up, it would perhaps contain no item of more immediate importance than an interrupter for an oscillating circuit which shall be efficient in transformation, maintain indefinitely oscillations of an exact predetermined character, be adjustable to the best conditions over a wide range of oscillations, and at the same time be inexpensive and simple of application. Such an apparatus appears to have been devised by Mr. Hewitt, and should the bright promise held out by the principles involved be realized in practical commercial operation, the art of wireless telegraphy will be enormously benefited. The electric arc as an interrupter by means of which to set up oscillations has proved far from satisfactory. Owing to the lack of a method of measuring the energy sent out by a Hertzian transmitting circuit, there are no data as to the efficiency of transformation in an oscillating circuit, but the loss at the arc is undoubtedly very great, and probably another great part of the energy supplied is dissipated in actions not contributing to setting up useful oscillations. Moreover, the action of the arc is not uniform, being subject to fluctuations and also dependent on the state of the electrodes as well as other local conditions. On the other hand, all of the factors entering into the interrupting action of the vapor tube would seem to be subject to exact control, and the discharge to possess a uniformity impossible in the use of the mobile arc. As in the case of the same inventor's apparatus for converting alternating to direct currents, the simplicity and inexpensiveness of the device is remarkable. An advance which substitutes for the paraphernalia of the disruptive gap a device as simple of connection and operation as the incandescent lamp, is indeed a most notable one.

THE MERCURY ARC.

We take great pleasure in presenting elsewhere an article by Mr. C. P. Steinmetz on this very interesting subject. As he very pertinently remarks, it is in the selective radiation of gases that one must seek for high efficiency in artificial illuminants, for the attempt to obtain it by the use of very high temperatures in solids is blocked by their physical incapacity to stay solid. Selective radiation in solids is not marked enough to lead to very striking results, and even the Welsbach mantle owes more to temperature and less to selective action than is generally supposed. With gases, however, the case is different, although as Mr. Steinmetz points out, it is perfectly possible to find a gas giving too much invisible radiation for good efficiency. The attempts at getting a good result from ordinary Geissler tubes have not led to decisive results, partly perhaps from the need of high frequency, but mainly because the mass of light-giving material in the highly exhausted tube is too inconsiderable to permit of attaining a reasonable intrinsic brilliancy under ordinary conditions. The mercury arc allows a considerable amount of energy to be transformed in a tube of reasonable size, and gives intrinsic brilliancy high enough to keep the dimensions of the apparatus moderate without producing, on the other hand, the painfully dazzling effect of high temperature illuminants in general. More than this, the mercury arc is particularly well adopted to the customary direct-current systems of distribution which makes it of immediate applicability.

In principle, the mercury arc is not new, having first been described in print nearly forty years ago, and it was studied by Dr. Arons more than ten years ago. Its present prominence, however, is due to the recent able work of Mr. Cooper Hewitt, who in the mercury vapor tube has developed the principle to a proximate commercial stage. The greater interest at present centers around the starting devices, on which much ingenuity is being expended. Dr. Weinstraub's plan, which we illustrate, is beautifully simple and effective, although open to the objection of requiring any given tube to be placed in a fixed position. The mercury arc is certainly highly efficient, requiring roughly about half a watt per candle power, can be regulated with comparative ease, can be conveniently worked in the series connection, is apparently of very long life, of convenient intrinsic brilliancy, rather insensitive to moderate variations of voltage and when properly arranged, remarkably steady. The light has very great actinic power, so that it has found a ready application in photography, and the lamp can be operated wherever direct current is attainable. Such a list of virtues cannot fail to be rather alluring, and we do not doubt that the mercury lamp when put out commercially will find sufficient encouragement in the use of incandescent gases to stimulate greatly all work in this interesting and, in our opinion, important field. We cannot believe that the mercury arc constitutes the last word on this topic, for with all its good points it has a fault that must bar it from the field of general illumination—its truly disagreeable color.

It is with respect to this latter point that we have to express total disagreement with the views of Mr. Steinmetz, and we fancy that he will find precious little support in his physiological and æsthetic theories regarding blue lights. There is certainly no sound basis for supposing that the red component of any light in practical use has any effect whatever that is deleterious to the eye. That the red component is not one to which the eye is sensitive has long been known, but for that matter neither is the blue, the yellow and green component, being those which are most effective for visual purposes. In fact, Crova proved years ago that the visual effectiveness of lights is practically proportional to their yellow components. The mercury arc lacks almost completely the red and orange components of white light. Hence by it the normal eye becomes as if red blind, and, as Prof. Boys recently put it, the color sense seems to go crazy. There is no relation between this total lack of one of the primary colors and such mild idiosyncracies as are found in other commercial illuminants. The net result is a light ghastly to a degree unapproached even by a Welsbach mantle at its worst. This failing must inevitably limit the usefulness of the present mercury arc to places in which color is without importance and appearances are scorned.

BOSTON LOCAL A. I. E. E. MEETING.

There have been meetings of the Institute at Boston in the past, but they were meetings of the membership as a whole. Last Wednesday, however, witnessed the first meeting of the Boston local branch of the Institute. There were no fewer than three past presidents of the Institute in attendance, besides President Scott, several vice-presidents, the secretary and other officers. The meeting was well attended and the speaker, Mr. Lockwood, was in the best and wittiest of moods. Several local branches of the Institute are now in full swing, including the very flourishing one at Pittsburg, an account of the recent meeting of which is reported elsewhere in this issue. The success of this excellent movement is largely owing to the untiring industry of President Scott, and it is to be hoped that these local meetings will continue to flourish and do good work by discussing papers, developing subjects of interest and introducing new members.

THE PHOTOMETRY OF ELECTRIC LAMPS.

A paper on this subject has recently been read by Dr. Fleming before the British Institution of Electrical Engineers. The author lays considerable stress upon the pentane flame standard as a primary standard, placing it in the same class with the Violle molten platinum standard; whereas the Hefner-Alteneck amyl-acetate lamp is relegated by him to the class of secondary standards. We should have supposed that the pentane and amyl-acetate flame standards would have been associated in the same category. But the more one reflects upon the Violle standard, the more hopeless its use appears, except, perhaps, in National Standard Laboratories. The pentane 10-candle lamp seems to have driven the parliamentary candle out of its stronghold—Great Britain—except in name. The apparatus employed by Dr. Fleming in his preferred form of photometer has certain interesting peculiarities. Electrically, he rejects all measuring instruments save the potentiometer. The standard lamp has an extra large bulb, to diminish the rate of blackening, and a filament which has been suitably aged in a separate lamp-chamber. The lamp tested is not rotated about a vertical axis, as is usual with us, in order to arrive at the mean horizontal intensity; but the maximum and minimum horizontal intensity are respectively noted, and in addition thereto, the "end on" intensity is also observed. The rating recommended by Dr. Fleming involves, therefore, three coordinates. This does not seem nearly so desirable as a single coordinate, such as the mean horizontal intensity or else the total flux of light. If accuracy of rating is aimed at, the mean spherical intensity, or the total flux of light, is much better. If convenience with commercial accuracy is desired, the mean horizontal intensity is better.

CHARACTERISTICS OF ELECTRIC EARTH-CURRENT DISTURBANCES AND THEIR ORIGIN.

A paper on this subject has recently been written by Mr. J. E. Taylor and communicated to the Royal Society by Sir Oliver Lodge. It contains a number of interesting suggestions. Everyone who has listened to the babblings of a telephone inserted in a ground-return circuit knows of the boiling and frying sounds that are always detectable by the ear. Mr. Taylor has been experimenting on a British Post Office wireless telegraph scheme, in which a telephone receiver is connected in a low-resistance circuit "earthed in the sea" at both ends. The noises heard in this telephone receiver at times when no wireless telegraph signals were being sent are divided into four characteristic classes, substantially as follows: Rushing water, boiling water, crackling and rocket disturbances. The latter are described as commencing with a shrill whistle and as dying away in from 2 to 4 seconds, with a note of diminishing pitch. These rocket noises are described as being heard freely by night, but rarely by day.

The ingenious suggestion is offered that the rocket noises are due to celestial rockets, or meteors. The sound suggests them, and their duration corresponds to the visible duration of meteors. The meteors are supposed to produce an electrical disturbance high up in the air, inductively influencing the ground or ocean, and thus leading to detection in the telephone. This is a hypothesis that seems readily capable of being tested. According to it, all that has to be done is to take up a telephone in a ground-return circuit at night, when no one is talking over the circuit, listen for rocket sounds, and watch for meteors. Since many meteors per hour are ordinarily visible on a fine night, when pains are taken to watch for them, the coincidence of visible and audible rockets should be capable of determination. Moreover, Leonid nights should give especially choice rocket disturbances in the telephone. The experi-

ment is not likely to be capable of trial in a large city, or near a trolley system, or near a large telephone exchange. We recommend it to our country friends far from the madding crowd. Mr. Taylor thinks that the reason why rockets are heard much more frequently by night than by day is not because there are fewer meteors when the sun is looking on, but because the sun's rays ionize the atmosphere to some extent and make it very feebly conducting. Consequently, the earth and the telephones thereof are electrically shielded at such times from the inductive disturbances of shooting stars, by the thin veil of aerial conducting matter. This suggestion also conforms with the generally accepted belief that long-distance wireless telegrams carry considerably further by night than by day. A feeble daily conductivity of the air owing to the work of our grand luminary, would be capable of explaining the greater diurnal than nocturnal attenuation in wireless electric impulses.

If this suggestion for the origin of telephonic rocket disturbances can be actually substantiated, the result will be important in various ways. It would be worth something to know that we can hear the flight of a falling star. Moreover, these celestial high-flyers move and have their brief but brilliant existence at a great elevation above the earth's surface, where no balloon is ever likely to take us. We can move nearly all over the surface of our planet; but five miles upwards and one mile downwards are the approximate limits of our travel in these less favored directions. It goes without saying that any electrical communications capable of being detected from these lofty visitors should be able to yield valuable information after appropriate study. A similar suggested explanation is offered for the diurnal variation of the magnetic needle. The impact of the higher frequency solar radiations on the molecules of the atmosphere disrupts a few of them, so as to knock off chips, or electrons, from these, thereby producing a feebly electrified and conducting atmosphere, the currents in which, reaching their maximum intensity early in the afternoon, influence the earth's magnetic field, and affect the alignment of suspended magnetic needles on the earth's surface.

THE ELECTRONIC THEORY.

A recent and valuable paper, presented by Sir Oliver Lodge to the British Institution of Electrical Engineers, discusses matters at the base of matter itself. It starts with the supposition that since the inertia of electrified matter is capable of being explained electromagnetically the simplest way to explain the phenomenon of inertia is to assume that all matter is electricity. Up to the present time, the electronic theory of J. J. Thomson and his school has postulated the existence of material corpuscles, or chips of atoms. Each chip that can be detached from an atom is negatively electrified, or constitutes a negative electron. The chip has been regarded as a piece of matter, although an exceedingly small piece, and as carrying an electric charge. In the paper under consideration, however, the electronic charge carried by the corpuscle is regarded as the corpuscle itself. That is to say, instead of assuming a nucleus or core of matter to carry the electronic charge, the charge, as a sort of magnified point-charge, is regarded as the corpuscle. All matter is assumed to be built up of these electronic charges or electrons, which are both negative and positive. A hydrogen atom is supposed to contain about 700 of these electrons. A mercury atom is reckoned to have 200 x 700 or 140,000 electrons all stowed away inside. The atom itself is taken as a sphere of one-tenth of a bicron in diameter, or 10^{-10} metre, so if there are 140,000 electrons stowed away into this little space, one might suppose that they are tightly packed. But, on the contrary, since the diameter of the electron, to account for its inertia, has to be 10^{-13} metre, or the millionth of a bicron, there is so much elbow-room for the 140,000 supposed inhabitants of the mercury atom, that they are roughly as distant from each other, relatively to their size, as are the planets in our solar system.

This speculation opens to our minds the conception of a complete solar system all shut up within the space of one-tenth of a bicron. The electrons perform orbits inside these little spheres, but the place which our sun occupies in our visible planetary system seems to be vacant in these atomic systems. According to the hypothesis, the electrons do not swing about a grand central electron, but about one another. The difference between one kind of matter and another lies in the physical and chemical properties of the atoms; but the difference between the atoms is merely due to the difference in groupings of electrons. A heavy atom like mercury would have a relatively large number; while a light atom, like hydrogen, would have but a relatively small number. Every atom is composed of positive and negative electrons, or vagrant electric charges, in space. Just how such a charge exists in space or what its mechanism is, does not yet appear. We can merely regard it as an electric point-source. The same hypothesis suggests to the mind the analogy that our visible planetary system may only be an atom in material aggregation on a sufficiently enlarged scale.

All chemical affinity is traced to aggregations of electrons, or atoms, with odd or unbalanced electrons either positive or negative. Chemical union is the result of the attraction of such unsatisfied electric charges on different atoms for one another. Cohesion is a less locally powerful, but more extended, electric attraction of groups of electrons in mutual linkage or satisfaction. Cohesion, in the electric sense, as in wireless telegraphy, is the artificially enhanced molecular attraction due to electric stimulus and the momentary inductive displacement of groups of electrons. Lenard rays and cathode rays are regarded as moving electrons, that is, trains of minute negative electric charges flying with great velocity. Röntgen rays are trains of solitary waves of radiated energy emitted at the impact of flying electrons with stationary groups of electrons, *i. e.*, solid matter. While, therefore, a cathode ray or Lenard ray consists essentially of electric charges, Röntgen rays do not contain charges but electric disturbances in ether radiated off or shed from the moving electrons, on being arrested.

The free path of a free electron moving into a solid body as dense as platinum is given as about a micron. This is about a billion times the electron's radius. The relatively great length of probable free path, before encountering other electrons is, of course, due to the large elbow-room or spacing between electrons even in dense matter. In matter of lower density such as aluminum or wood, the mean free path becomes correspondingly magnified. When collision does occur, it is suggested that it is rarely a clean encounter like that of two opposed locomotives on one and the same track, but nearly always such a sharp swing as a comet makes around the sun at perihelion, the two sides of the hyperbolic path leading to and from the sun being virtually straight lines, and the return virtually a rebound of the comet from the sun as viewed by a very distant observer. The power required to stop a single electron moving at a velocity of one-thirtieth that of light, within the thickness of a single molecule, is set at about ten watts.

The Lodge theory of the electron appears to differ then from the Thomson theory mainly in postulating that there is no matter in an electron or corpuscle, and that this little fundamental unit is all electric. Thomson's theory means that negative electricity is matter. Lodge's theory means that all matter down to the ultimate corpuscle is electricity. The difference in thought between the two theories is quite appreciable; but there is so little matter in an electron that it matters little to which we pin our faith.

Meeting of Pittsburg Branch of A. I. E. E.

A meeting was held February 5 of the Pittsburg local branch of the American Institute of Electrical Engineers, at the Electric Club. The papers presented at the New York meeting, together with President Scott's introductory remarks, were read by Secretary John S. Peck. The discussion which followed was participated in by Messrs. Grace, Bradley, Lincoln, Gallagher and Hommel. As a part of the discussion, Mr. Grace read a communication in which he commented on the papers of Messrs. Hammer and Lockwood, and Mr. Bradley presented a communication discussing the installations of switchboards and a general system of standardizing apparatus. A communication from Mr. Sidney Hand Browne on Mr. Lockwood's paper was received after the meeting adjourned.

Mr. Bradley sketched the progress of telephone installation engineering from the day when all of the work except building the switchboard proper and distributing frames was done by the foreman at the time of installation. The multicolored insulation scheme was later introduced, the cables cut and soldered to the multiple jacks at the factory and elaborate specifications prepared and plans furnished showing the location of the switchboard, power plant, conduit, etc. When the common battery board was planned the work increased greatly owing to the number of cable runs, more apparatus and power plants of larger capacity. It was found that by locating exactly each piece of apparatus, the racks for carrying the cables could be designed accurately and built in the shop, conduit plans be prepared and, in fact, innumerable details that were formerly left to the installer were now figured out by the engineer before the installation actually started. Particular attention was paid to the arrangement and location of apparatus on the switchboard proper so that the cable work could be done in such a way that all apparatus would be accessible and easy to maintain. To-day practically all cables are cut and formed from plans made by the engineer and are soldered to their respective terminals or jacks before they leave the factory.

The communication by Mr. Browne referred to improvements in switchboard details whereby the cable required in wiring multiple jacks is reduced two-thirds, the use of a shunt to put out the supervisory lamp is avoided, the use of a repeating coil in the cord circuit is dispensed with and also the third contact in multiple jacks. Figs. 1 and 2 show two telephones connected through a telephone exchange system, whose operation is as follows:

The operation of removing the receiver from the hook of the sub-station instrument closes the circuit and energizes the line signal-

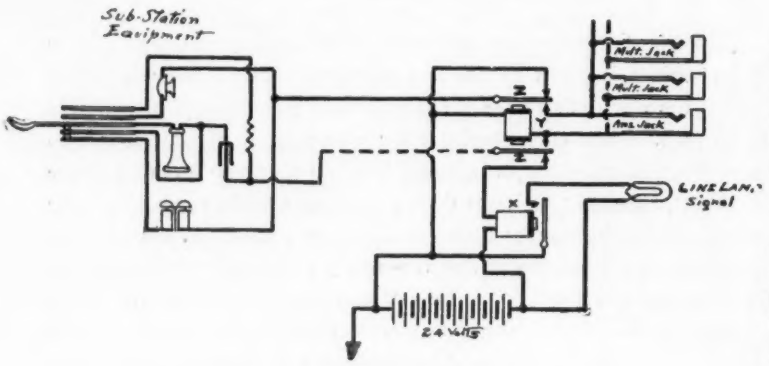


FIG. 1.—TELEPHONE SWITCHBOARD CONNECTIONS.

relay, X, in the usual manner. The operator, by inserting the plug in the answering jack, allows current to flow over the ring of the plug through a relay, Y, of high impedance, to the ground; this relay being energized attracts its armature, Z, and disconnects the line signal apparatus, consisting of relay, X, and lamp, and also "puts current" on the sleeve of the jack which will give the busy test through a relay, T, placed in the operator's circuit. The advantage of this relay controlling the busy test is that by its use the operator only gets the signal without conveying it to the subscriber who has made the call. The insertion of the plug also causes current to flow through relay, P, closing the local contact at L, and allows current to flow through the lamp to the local contact at L on relay, R, to ground. These relays are of low resistance and are placed on each side of the cord circuit. When the subscriber answers his call by taking the telephone from its hook, it allows the current to pass back over the tip of the cord to relay, R, to ground and opens the local contact at L, thus cutting out the supervisory lamp. It will be noticed that there is a straight through circuit from the tip and sleeve of the answering cord to the tip and sleeve of the calling cord, with the condensers, C^1 and C^2, inserted. These condensers permit the flow of voice currents and prevent the steady flow of current from the battery, which simply simplifies current for the sub-station transmitter.

The system described eliminates undesirable features, and while it is true that the relays, R and P, and R^1 and P^1 are introduced, these relays are wound to a high impedance and are not connected directly in the talking circuit, but are bridged across it. The circuit is perfectly balanced and instead of shunting the lamp and allowing current to flow through the lamp circuit, the lamp circuit is opened and a drain on the batteries thus avoided. The amount of wire

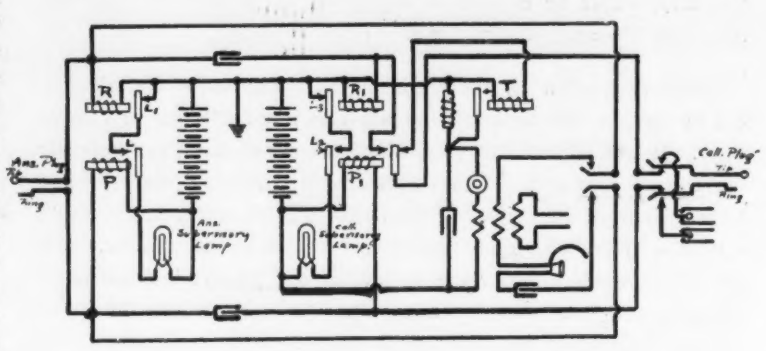


FIG. 2.—TELEPHONE SWITCHBOARD CONNECTIONS.

necessary in a large multiple switchboard and the consequent greatly increased cost of manufacture renders obvious the immense saving can be made by the elimination of one-third of the amount of multiple switchboard cables, by the use of two-contact jacks instead of three-contact, by the use of two-conductor cords instead of three-conductor; while at the same time obtaining a much more direct and better talking circuit.

At the same meeting Mr. R. A. L. Snyder presented a communication on the speaking arc, which is reprinted elsewhere.

Inauguration of Boston Chapter of the Institute.

One of the most representative assemblages of electrical engineers that has ever convened in Boston met on the evening of February 13 to take part in the opening meeting of the Boston Chapter of the American Institute of Electrical Engineers. Men of note in their profession from all over the eastern section of the country were present and from New York a special delegation came on to attend the affair. Everything combined to make the Boston meeting successful and full of promise for the future.

Prof. Elihu Thomson presided. In his opening address he spoke of the place that the electrical engineer holds in the world to-day, of the tremendous growth of the science in the past and of the brilliant future that stands before it. He touched on the position which the American Institute occupies in connection with this, and then introduced President Scott to elaborate on that subject.

President Scott went into details of the Institute, its work, aims and the way they were being carried out. On the same subject and in discussion of the paper of the evening, Secretary Ralph W. Pope, Dr. Samuel Sheldon, Dr. A. E. Kennelly and Mr. Louis A. Ferguson, president of the Chicago Edison Company, also spoke. The paper read was Mr. Thomas D. Lockwood's "Evolution of the Telephone Switchboard." Mr. Lockwood himself presented it and gave a most interesting talk to the two hundred men present.

These meetings, of which this was the first, are to be held monthly in one of the buildings of the Massachusetts Institute of Technology. The Tech students in electrical engineering, who have an organized society of their own of nearly one hundred members, also attend them jointly with the older men. It is the hope and expectation, as President Scott remarked, that the young blood infused into these affairs will carry the Boston organization on to a prosperous, worthy place among the professional societies of the city.

1,000-H.P. Water-Power Electric Plant at Manchester, Conn.

ABOUT nine miles east of Hartford, Conn., is situated the thriving village of South Manchester. Here is located one of the most important industries Connecticut boasts of, namely, the immense silk mills of Cheney Brothers. This establishment is the largest of its kind in New England, if not in the United States, and has been under the direct management of the Cheneys for several generations. Their silks are well known to every merchant in the country, for fine quality and finish.

As in the case of most manufacturing establishments, steam, until recently, has furnished all the power for these silk mills. The

FIG. 1.—POWER HOUSE.

great success for the past three years of the Hartford Electric Light Company in utilizing the falls of Farmington River, at Tariffville, Conn., and transmitting the product of the water wheel and generator fourteen miles to light the city of Hartford and furnish power to customers there, has opened the eyes of alert manufacturing and business men of that section to the possibilities of the various water powers in their neighborhood, and, of course, their great economy over coal. Though the first cost is considerable, the operating expenses, repairs and incomes are usually greatly in favor of the hydro-electrical plant over those of the steam plant,

FIG. 2.—DAM AND GATE HOUSE.

though with the high-efficiency engines, to say nothing of the steam turbine, the latter is a good investment in the city of Hartford.

The water plant of the Hartford Electric Light Company, running continuously every hour since its start three years ago, has called upon the auxiliary steam plant in Hartford but very little, and for the past year scarcely at all, while for this period of time the amount expended for repairs was too small to take into account. So it was not a surprise that the progressive spirit of the Cheney Brothers, near by, should manifest itself by the purchase, early in 1901, of three dilapidated powers of eight, ten and twenty-two feet fall on the Hockanum River at Manchester, Conn. They engaged Mr. A. C. Rice, of Worcester, Mass., the designer and engineer of the above-mentioned hydro-electrical power plant of the Hartford Electric Light Company and many other large developments, to take these three water privileges and deliver their power to their mills in South Manchester, about three miles distant. Mr. Rice accordingly made plans to consolidate these falls into one and control the water supply in one pond.

To accomplish this it was necessary to raise the elevation of one of the old dams and conduct the water by a steel feeder pipe to the site of the power house on the fall farthest downstream. The old dam was a stone structure erected a great many years ago and crowning upstream in the shape of a slight arch. It was found necessary to remove a few of the top courses and to thoroughly clean the exposed faces and joints of the old masonry before applying the new concrete. Thus a concrete dam was constructed thirty feet high, with an ogee face, by using the old masonry as a core wall and adding a new concrete apron and rollway, and sealing the back by a thick layer of concrete.

The dam runs across the river for a distance of 130 feet and then turning an angle runs parallel to the river for 210 feet to the waste gate abutments and gate house. From the gate house a dike ten feet high runs back 160 feet to the natural level. The gate house covers the entire forebay and racks, as well as housing the gate irons. A steel bulkhead, with three wooden head gates, shuts out the water from the portion of the forebay leading into the penstock. Slat flooring in the gate house admits air to this chamber and thus relieves the pipe when the head gates are closed.

The waste gates on the dam are operated by an ingenious mechanism, designed by Mr. Rice, by which one man can with ease operate them. The gate stem, instead of having a rack and pinion, consists of a single rod threaded to run through a nut resting on ball bearings in the head of the apparatus, which is operated by a pair of bevel gears and crank, the working parts being encased and protected from the weather.

From the gate house the feeder pipe nine feet in diameter, built of 5/16-in. steel and single riveted with inside and outside sheets, runs downstream along the river bank for a distance of 2,700 feet to the power house. Two lap expansion joints were provided to take care of the expansion and contraction, as a large part of the pipe lies half exposed above ground. For the first few hundred feet the pipe lies on the bottom of the old canal that supplied water

FIG. 3.—DAM AND WASTE GATE IRONS.

to the abandoned mills along the river, and has been entirely buried. Just before the water reaches the wheels it passes through a stand pipe twelve feet in diameter and fifty feet high, which stands near one corner of the power house. It is built of 5/16 and ¼-in. steel. The stand pipe was necessary to relieve the feeder pipe, which is so long that the sudden changes of load upon the water wheels would otherwise produce great strains upon the pipe caused by water hammer.

From the stand pipe the water passes into the flumes of the two wheel units, which are erected on steel beams and concrete piers

in the rear of the power house directly over the tail-race, so only the flume head projects into the power house.

The power house is a neatly constructed brick structure 32 feet wide by 48 feet long. The roof is covered with standing seam steel roofing laid on two-inch planking planed and beaded on the under side. The purlins supporting this planking are also finished, and are carried by two steel trusses, the bottom chord of which is twenty feet clear of the floor.

Two tall, broad windows on every side of the building furnish abundance of light, while the large double doors will admit the largest piece of machinery easily. The window sills and underpinning are rock-faced cut red sandstone. The floor consists of six inches of concrete dressed on top with a finish coat of neat

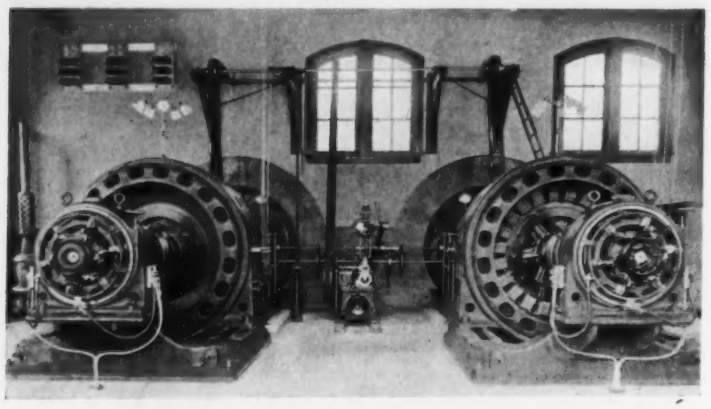


FIG. 4.—TWO UNITS WITH SINGLE GOVERNOR.

cement. The generator foundations are large blocks of concrete and the tail-race walls are also concrete.

The water wheels, designed specially by Mr. Rice, consist of two pairs of 24-in. horizontal turbines, rated at 510 hp each, with a speed of 327 revolutions under a head of 36 feet. Although the total head is 40.5 feet, an allowance is made to draw the storage pond 4.5 feet. On the shaft of each wheel is a momentum wheel six feet in diameter, weighing 5,250 pounds and running with a peripheral speed of 6,164 feet per minute. It is built of steel plates riveted together, and is guarded by a brass railing.

In the governing apparatus of the water wheels a very novel feature has been introduced. One Lombard governor is used to govern the two wheels, whether only one of the two or both are running together. The governor is placed centrally between the

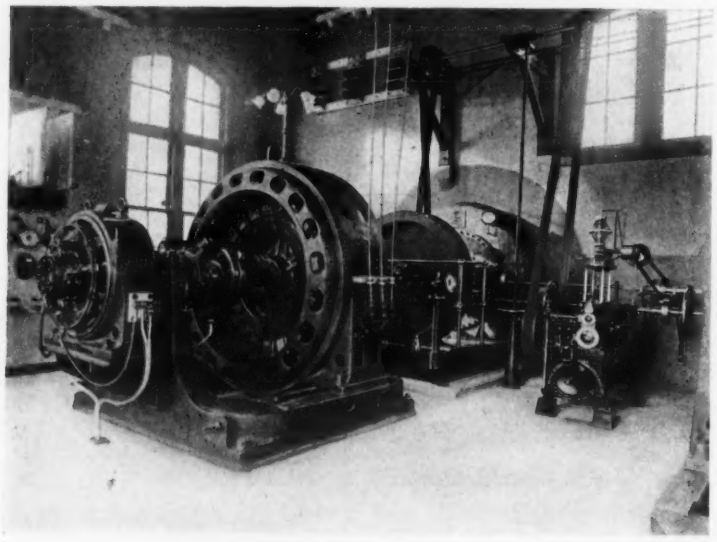


FIG. 5.—SINGLE UNIT WITH GOVERNOR.

two wheels. An overhead shaft with specially designed friction clutch pulley at each end, is driven by a quarter twist belt from each wheel. This shaft drives the pump of the governor, and as the friction pulleys are connected to the same shifter, which is operated by a hand wheel on a vertical rod standing near the governor, the shaft is driven by merely throwing out the friction pulley driven by the wheel that may happen to be not running. A smaller shaft on a level with the wheel shafts and behind the governor is used to drive the speed balls of the governor. This shaft is divided in the middle and each part is driven by a small belt from the shaft of each wheel in a similar way to the pump shaft. The governor balls are driven by a belt that can be shifted from one part of this shaft to the other. It was found necessary to have these two separate shafts, as the jerking of the pump interfered with the driving of the sensitive speed balls by the same shaft.

The gate shaft passes through the governor to the racks of each wheel and has a special lock coupling to disconnect the part operating the gates of the idle wheel. A hand wheel on each part of the gate shaft is used to open the gates of each wheel if one or the other should not be running; then if more power is required and the second unit is to be started, the gates of the idle wheel are opened by means of the hand wheel to the same opening of the first wheel, and the gate shafts connected by means of the lock coupling, when the governor immediately takes hold and regulates the gates to the required load. It is, of course, understood that the generators are then connected on the switchboard when they are in synchronism and run in parallel to carry the whole load. Each wheel is supplied with tachometer and pressure and vacuum gauges.

The generators are direct-coupled to the water wheels. They are Westinghouse make, 300-kw, 6,600-volt, 3-phase, revolving-field, self-exciting type. As shown in the photograph, the exciter is mounted on the free end of the generator shaft, and thus driven at the same speed as the generator. These are 25-kw, 125-volt machines. One exciter is capable of exciting both generators if the other exciter is disabled.

A four-paneled switchboard stands at one end of the building, with which the generators are connected by simple, neat overhead wiring. The lightning arresters are grounded to the penstock.

The transmission line is about three miles long and consists of three strands of copper wire and runs to the Cheney Brothers' mills in South Manchester. Here the 6,600 volts alternating current is transformed to 440 volts direct current and is used to light the entire plant and drive the machine shop, carpenter shop and velvet mills. As fast as they can make the changes to install motors in other departments, the water power plant will be called upon to furnish power to the last drop of water in the river, while the present steam plant will be kept as an auxiliary to furnish power during periods of low water and heavy loads.

Contractor David Waite, of Holyoke, Mass., executed the work of building the concrete dam, the gate house, dike and power house. The American Bridge Company built the steel bulkhead and racks. The Riter-Conley Manufacturing Company, of Pittsburg, Pa., erected the feeder pipe and stand pipe. The Eastern Bridge & Construction Company, of Worcester, Mass., furnished the structural steel work

FIG. 6.—PIPE LINE.

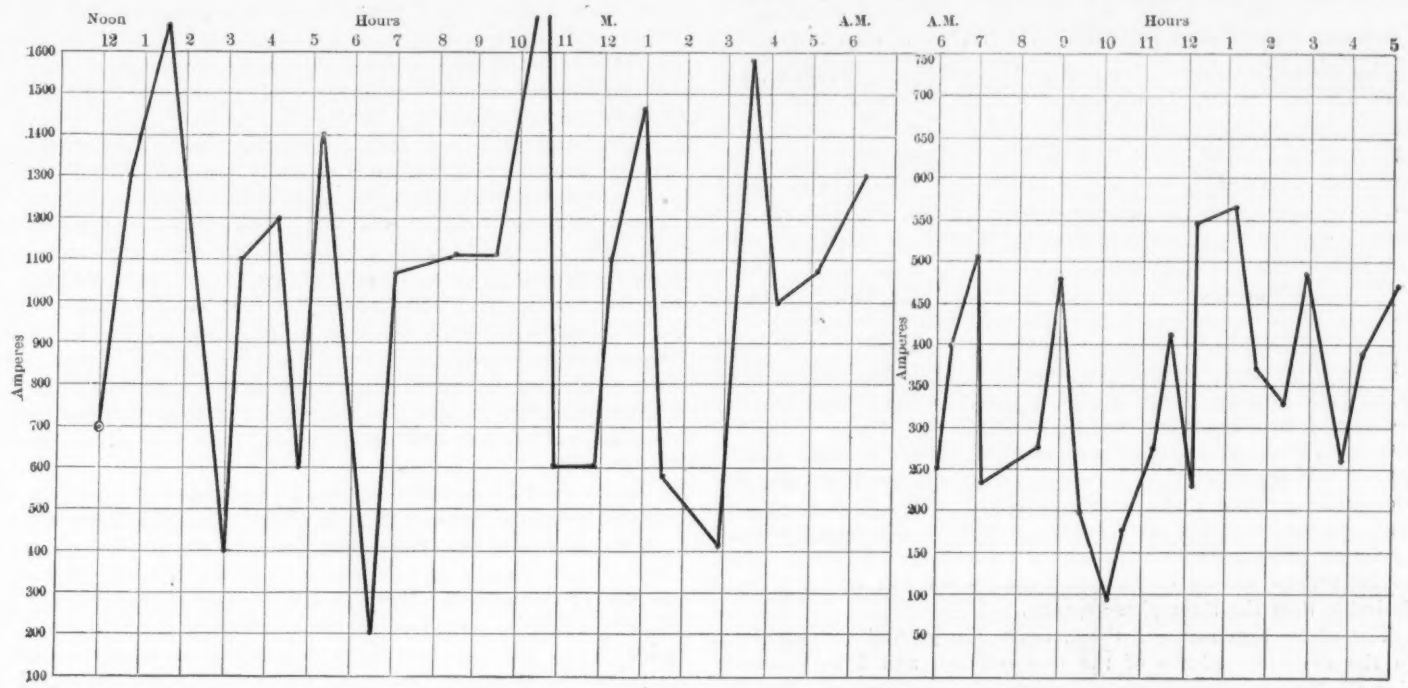
for the power house. The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, built the water wheels with the draft tubes and momentum wheels complete to the generator coupling. The Lombard Governor Company, of Boston, Mass., furnished the water wheel governor. The Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., furnished the entire electrical equipment. Mr. A. C. Rice, consulting engineer, of Worcester, Mass., was designing engineer, and G. R. Stattlemann, of Dayton, Ohio, was resident engineer.

Alternating vs Direct Current, as Applied to the Iron and Steel Industry.

BY C. H. HINES.

THE question of the relative merits of direct and alternating-current in the operation of the varied mechanisms of the great iron and steel mills of the country, is an open one, and while both systems have their ardent advocates the champions of the alternating system are at the present time handicapped somewhat by the fact that there is at present no large mill in this country so equipped, although on the continent of Europe there are several which give the utmost satisfaction. This condition of things is, however, rather owing to the conservatism of the mill managers and to the fact that most of the large installations took place at a time when the alternating current was passing through the experimental stage, than from any actual reason against the same; and at the present one of the largest mills in the country is being equipped throughout with the alternating current.

The conditions to be met with in equipping a steel or iron mill are peculiar, as they present certain characteristics not found elsewhere. In view of the large initial outlay, and the absolute necessity of continuous and efficient service under the most unfavorable conditions, too much care cannot be taken in deciding on what is best suited for the case.



CHARTS OF LOAD VARIATIONS.

The three principal things to be considered in regard to this class of work are, first, durability; second, efficiency; and last, but by no means least, simplicity. I mean by this that the apparatus must be such as can be intrusted to unskilled labor for manipulation without injury, or the chance of such injury must be reduced to the narrowest possible margin. With these factors always before us, let us now proceed to investigate the especial claims of the two systems.

A large proportion of the motor load in these places will consist of motors requiring a high starting torque and variable speed, and these conditions are more nearly met by the direct series-wound motor. It is right here that the advocates of the direct current base their strongest claim; for while it is quite possible to install an alternating-current motor which will give the desired effects, yet we then introduce a costly and complicated piece of mechanism in the system of control, which runs up the initial cost and adds more apparatus to get out of repair still, when the question of maintenance is brought into the question, then even this costly affair will more than hold its own with the direct-current motor. Now, could we have a series-wound alternating motor there could be no comparison between the two, and when we compare the shunt-wound, direct-current motor and the induction alternating motor, the advantage all lies with the latter. The shunt-wound, direct-current motor is an essentially electrical piece of machinery and its commutator is always a constant source of trouble and expense, while the induction motor is really a mechanical piece of machinery and is the simplest form of a machine devised to perform work known, which will do its work faithfully day after day with little or no attention save oiling. This is a most important fact to be considered, as spare armatures, commutators and the expense of hiring competent men to keep them in condition will run up a high bill for repairs per year, and each spare armature and part represents the lost interest on the money so invested in addition to the money lost caused by delays while repairing or changing armatures. As this affects directly production, the cost may run up into large figures. So we may say as regarding series motors, the alternating current at least holds its own, and as regards direct-current shunt motors, it is by far superior.

Now we come to the question of voltage to be carried. The present practice in such places limits the voltage carried to from 250 to 550 volts, with the preponderance largely in favor of the small figure. This is very necessary, as the wires are exposed to intense extremes of heat and cold, flying iron and steel dust, graphite, and grease, which will quickly deteriorate the best insulation that can be installed; and despite the most careful attention "grounds" are a never-failing source of trouble. Thus it is easily seen that on account of danger to life and property the lower the voltage the better. With this necessary low voltage and the large units of power that are required, the question of copper comes to the front, even though the distance to which power is required to be transmitted is not great. Even in a distance of three or four thousand feet, when as many thousands of kilowatts of power are to be transmitted the cost of copper leaps into the thousands, leaving aside the question of increased expenditure for the pole line, which to be secure will necessarily have to be built of structural iron set in masonry, thus still further running up the bill of costs. There may be thus forty or fifty thousand dollars' worth of copper cables which represents more idle money, not only drawing no interest, but requiring an annual "writing off" for depreciation.

Now we will consider the question of the alternating current at the same low voltage. Although we can in this case dispense with transformers and run our motors direct from our generator, still the same question of copper confronts us. Let us now consider a voltage of 2,200 for our primary line, and the cost of copper drops at once to three or four thousand dollars and the difficulties of the pole line to nothing; and even with the cost of transformers added, the total cost is below that of the lower voltage, the initial voltage on the primary lines is entirely safe and by judicious grouping of transformer banks you have here the perfect system.

I append here the figures of a hypothetical plant embracing both features based on transmitting 3,000 kw of power 5,000 ft., using

alternating three-phase currents at 600 volts, a power-factor of 85 per cent., frequency, 25, and using iron poles.

Copper required	18,377,000	circular mils
347,025 lbs. of copper at 14 cts. per lb		$48,583.50
125 iron poles at $46.20 each		5,775.00
375 iron cross arms at $2.24 each		840.00
65 bbls. of cement at $2.20 per bbl		143.00
Labor on poles, concreting, etc		375.00
2250 insulators at 6¼ cts. each		140.62
2250 locust pins, at $14.00 per thousand		31.50
Labor, sundries, spikes, ties, etc		625.00
Total		$56,513.62
Cost of transmitting same power and distance at 2200 volts		$56,513.62
Copper required	1,500,000	circ. mils
28,275 lbs. of copper at 14 cts. per lb		$3,998.50
100 poles at $4.50 per pole		450.00
100 cross arms at 20 cts		20.00
300 insulators at 10 cts. each		30.00
300 locust pins at $4.50		4.50
3000-K.W. of transformers at $11.00 per K.W.		33,000.00
Labor, sundries, etc.		150.00
Total		$37,653.00
Cost of transmitting at 600 volts		56,513.62
Cost of transmitting at 2200 volts		37,653.00
Difference in favor of higher voltage		$18,860.62

The above figures may vary slightly in different localities, and with different makers of apparatus, but the saving in cost of the higher voltage over the lower will remain about the same. The figures given for the lower voltage of alternating current may also serve for comparison with the direct current at 500 volts, but in that case the cost would be still greater, so that one can see at a glance the immense superiority of the high voltage alternating over any other form of transmission.

Now, having settled on the question of current and voltage, the next question that arises is what style transmission is best suited to the requirements of the case—whether three-phase or two-phase. The accompanying curves show the load variations taken from a typical plant and from a large number of readings; also a chart of readings from one motor of the type I have described. Here is seen a wider range and more abrupt peaks than even street railway service, and the question of balancing the phases becomes a not very easy task. From a study of these charts it would seem to indicate that a two-phase, four-wire system would be the easiest solution of the difficulty, even though it involve the cost of an extra feeder, as the greater facility of balancing the phases will render it more desirable than the three-phase system.

The above arguments, I think, cover the ground thoroughly as to the respective merits of the two systems, and I am confident that the large plants that may be erected in the future will find that the alternating current will be the equal of the direct in all things and its superior in most of them.

Moving Sidewalk Scheme for New York.

The proposal made by Mr. Max Schmidt, of the Multiple Speed & Traction Company, to Bridge Commissioner Lindenthal is that the city should build the subway under the city from Bowling Green to the new East River Bridge at an estimated cost of $3,200,000, and lease it to the Multiple Company at a nominal rent, the company agreeing to operate a moving platform transit system on the basis of a one cent fare. This proposition is now under consideration by the rapid transit commissioner and pending his report no other proposition will be made.

Since the above proposition was made a law has been pointed out by the rapid transit commissioner, prohibiting the city from making any investment that does not guarantee a return of at least 4 per cent. This will doubtless cause a modification of the company's proposal as to the terms of the lease, but not as to who shall build the subway.

The company has full confidence in the success of the moving platform system of transit, pointing to its success in other cities, and says it is willing to guarantee the city a return of 4 per cent. on its investment, but that it cannot do so on a one cent fare basis.

The Mercury Arc.

By Charles P. Steinmetz.

While the electric motor is rapidly replacing all other methods of power transmission and distribution, due to its greater economy, electric power when used as a source of light is still at a disadvantage regarding economy. That is, as a rule electric power is more expensive than gas or kerosene, and the extensive use of electric light is due rather to its greater convenience, reliability and cleanliness than to its economy. This follows from the fact that the efficiency of producing light from electric power is extremely low, below 10 per cent. in the most efficient carbon arc lamp, and something like 3 per cent. in the incandescent lamp and the Nernst lamp.

It is obvious, then, that if the efficiency of light production could be raised to figures even half as high as that of power production, the electric light would sweep every other illuminant out of existence by its greater economy. These considerations led me some years ago to undertake a systematic research into the method of conversion of electric power into electric light.

The cause of the low efficiency of the present method of electric lighting is the use of heat as intermediary form of energy, which always involves an excessively low efficiency. The efficiency of production of light from heat by incandescence rises with the increase of temperature. But at the highest available temperature—the boiling point of the most refractory substance, carbon—the efficiency is still very low, probably about 10 per cent. for the crater light of the carbon arc.

The attempt to utilize selective radiation; that is the property of some substances to produce an abnormally large percentage of visible rays at apparently moderate temperature, has been successful in gas lighting and has given us in the Welsbach mantel a more efficient gas light But this increase of efficiency was due rather to the very low inherent efficiency of the ordinary gas flame. In electric lighting this principle in the Nernst lamp gives only about the same flux of light as in the incandescent lamp of the same power—one-quarter mean spherical candle per watt. The good feature of the Nernst lamp is the distribution of light rather than the efficiency.

The Geissler tube and the arc were investigated, since none of them follows the temperature law of radiation, but both give selective radiation.

The Geissler tube reaches reasonable efficiencies only at very high frequencies and so appears of no practical value as illuminant.

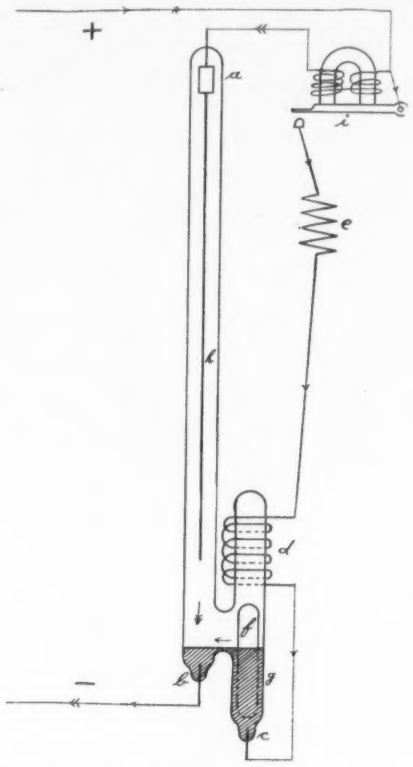
The spectrum given by luminous gases, as the arc flame, does not vary in wave length and consequently color, with the temperature as that of incandescent solids, but every gas or vapor gives light of certain definite wave lengths, the spectrum of the substance. The substance of which the spectrum is entirely or mostly within the range of visible wave length, would give a very efficient illuminant, while a substance as silicon, the spectrum of which is largely beyond the visible range, is inefficient as an illuminant. Here, then, high temperature of the light-giving substance is not instrumental in increasing the efficiency; but, if anything, higher temperature rather leads to lower efficiency, due to the greater loss of power by heat conduction and convection, etc.

This led to an investigation of arcs and arc spectra, which, while still continuing, has already given results of considerable practical value and great scientific interest regarding the constitution of matter and the phenomena of the arc and arc conduction. A short review only of the work relating to the mercury arc can be given here.

Owing to the poisonous character of mercury vapors, the mercury arc is preferably operated in a vacuum tube. Mercury arcs in a vacuum have been investigated by Dr Arons and others. The great difficulty in their use was found in starting. The common method of starting an arc by bringing the terminals into contact with each other and then withdrawing them, is rather impracticable with an arc several feet in length. Arons and later investigators started the mercury arc by sending a high-voltage discharge of several thousand volts through the vacuum tube, thereby breaking down the vacuum. This method appeared to me impracticable for general use since it practically precludes the use of the mercury arc in series connection, for which it is eminently suitable, owing to its low voltage. On a constant-potential circuit of, say, 110 volts, a mercury arc to consume 80 to 90 volts, would have a length of four to five feet, which

makes it rather awkward for use and gives a unit of light greater than desirable for most cases, while in a series circuit tubes of 12 to 18 inches length can be operated efficiently.

This difficulty was overcome by a very ingenious device developed by Dr. Weintraub, of the Research Laboratory of the General Electric Company, which permits starting the mercury arc by means of a small auxiliary arc without any increase of voltage over that at which it operates normally. One of the arrangements of the starting device is illustrated by the mercury arc shown as vertical tube in Fig. 1. It contains a positive terminal, *a*, for which graphite was found the most suitable material, and two mercury terminals, *b* and *c*, closely adjacent and on the same level with each other; *b* is connected to the negative *c* through the solenoid, *d*, and the resistance, *e*, to the positive. At open circuit the mercury overflows and connects *b* and *c*. When the circuit is closed the current first passes through the circuit shown by single arrows. The solenoid, *d*, lifts the iron core, *f*, out of the mercury cup, *g*, and thereby lowers the mercury level so that the circuit between *b* and *c* breaks and a small arc starts in this side branch. This arc in a vacuum instantly flashes up to terminal, *a*, and so establishes the arc in the main tube, *a b*, however long it may be. A carbon filament, *h*, extending from the



STARTING DEVICE FOR MERCURY VAPOR LAMP.

positive terminal a part of the way down the tube, greatly assists in starting. A cut-out magnet, *i*, in the circuit, *a b*, of the main tube shown by double arrows, may now either cut out the side branch, *b c*, or cut resistance into the circuit, leaving a small arc between *b* and *c*, which greatly increases the stability of the main arc.

It was found that of all the arcs the mercury arc probably is the most stable. While in the carbon arc with constant arc length the voltage consumed by the arc decreases with increase of current, in the mercury arc the voltage is constant irrespective of the current, so that in constant potential operation the amount of steadying resistance required for the mercury arc is less. The mercury arc is very little sensitive to even wide variation of voltage and current. For instance, since last summer I am lighting my laboratory and conservatory with a number of mercury arcs in series connection, which derive the power from the trolley circuit at the end of a long branch line, where the voltage varies excessively during the time of heavy traffic, between 5 and 7 P. M., fluctuating between 280 volts and 600 volts, while the current varies between 2.5 and 8 amp in the mercury arcs, without causing serious difficulties.

The efficiency of the mercury arc is about two to three times as high as that of the carbon arc lamp and four to six times as high as that of the incandescent or Nernst lamp, and does not vary materially with the current, so that the mercury arc offers an electric light which can be turned up or down without loss of efficiency.

The most prominent feature of the mercury arc is its bluish-green color. This is due to the deficiency of the mercury spectrum in red and orange rays. This feature is objectionable in some cases and advantageous in others, and will probably give the mercury arc a distinctive field of its own. Extended investigation showed that the harmful physiological effects of light, as observed when working for a long time with artificial illumination, are not due to the lower intensity of artificial illumination compared with daylight, but rather to the red and orange rays which predominate in the artificial illuminants. These harmful effects disappear by excluding the red and orange rays. The mercury arc, therefore, is the only known artificial illuminant which is perfectly harmless, and thus especially suited for use where accurate work has to be done by artificial illumination, as in drafting rooms, offices, factories, etc. In this respect it differs from the Welsbach gas light in which the greenish color is due to an excess of green rays superposed upon an excess of red and orange rays, and which, therefore, does not have the same harmless feature.

A strongly noticeable feature of the mercury arc is its penetrating power regarding distance. While the intensity of radiation obviously decreases for all colors proportional to the square of the distance, the sensitivity of the eye with decreasing intensity decreases much faster for red than for green and blue rays, so that the apparent physiological intensity of bluish-green light decreases with the distance much slower than that of red light; that is, of a red and green light of equal intensity the red light will appear much more intense and glaring at a short distance, while the green light will appear much more intense at a greater distance.

For color matching, however, the light of the mercury arc is unsuitable, as is also that of the gas or kerosene flame, only that with the latter the blue appears blackened, while with the former the red appears brown and the blue retains its full brilliancy.

The mercury arc gives specially brilliant effects wherever green is the preponderating color and is thus best suited for suburban street lighting, lighting of country seats, greenhouses, etc. The suppression of the red color gives all vegetation an especially vivid and fresh appearance, and the strong actinic character of the light gives a fluorescent sheen to many substances usually not recognized as fluorescent, such as glass, snow, etc. For indoor illumination in private residences, the mercury arc is, owing to its color, not well suited except when there is added to it the red and orange rays. This, however, lowers the efficiency owing to the inherently lower efficiency of red and orange light.

The mercury arc can be operated on alternating-current as well as on direct-current circuits, though thus far most of the development has been done in the line of direct current. In an alternating-current circuit the current passing through the mercury arc is unidirectional, passing only in one direction, so that any apparatus connected into an alternating circuit through a mercury arc receives a unidirectional current and the mercury arc acts as a rectifier. This feature is of interest in connection with the problem of conversion of alternating into direct-current power.

Stricter Wiring Rules in Chicago.

Since February 1 the Electrical Department of the City of Chicago has ceased to approve of the installation of concealed wires on insulating supports, commonly known as concealed knob and tube work. In all new buildings and in alteration work on old buildings, all new concealed wires must be encased in approved metal conduits. In wiring or re-wiring old buildings not liable to dampness, an approved metallic or non-metallic conduit may be used, provided that the department receives notice before contract is made for such wiring, so that it can ascertain that such portions of buildings are not liable to dampness. The new rule came as a surprise to many electrical contractors, and was based on the lessons taught by reports of electrical fires. There are rumors that even more stringent requirements will soon be made. A committee appointed by the board of underwriters is now preparing new rules for non-metallic flexible conduits, and there is a possibility that such conduits will be required to be fire-proof. Although the new rule at first thought seems to be rather stringent, it is in the line of progress and good work, and will make all wiring safe. There is no doubt that mechanical protection of wiring will go a long ways toward preventing fires caused by defects in the wiring itself.

Parallel Operation of Steam and Water Power Plants.

BY CHARLES BRANDEIS.

AN interesting parallel operation recently took place in Montreal, Canada, between two and three-phase system steam and water power plants, which may be worthy of note.

This event was caused by an unfortunate break in the main dam of the Chambly Power Company, 250 feet of the dam being carried away, causing a complete shut-down of the power house for several months. The Chambly Power Company, situated on the Richelieu River, about 17 miles from Montreal, supplies power to the Montreal Street Railway Company and to the company formerly known as the Royal Electric Company. Two years ago the Chambly Power Company, the Royal Electric Company and the Montreal Gas Works amalgamated under the name of the Montreal Light, Heat & Power Company.

The occurrence of this above-mentioned disaster on November 30th of last year, which deprived, at the season of maximum demand, the City of Montreal of some 20,000 hp, caused a virtual famine of electric power and required the united assistance of all available steam and other water power plants in the neighborhood of Montreal to prevent the necessity of shutting down some of the large and important factories and to give satisfactory service during the peak of the load.

The situation was interesting in that there were no less than 10 steam and water power plants, all situated at considerable distance apart working in multiple, as shown in the diagram. As will be seen, these plants, equally divided, are under the control of two powerful competitors, the Montreal Light, Heat & Power Company, and the Lachine Rapids Hydraulic & Land Company, one company operating on the two-phase, the other on the three-phase system, the Lachine Rapids Company supplying to its competitor 3,500 hp.

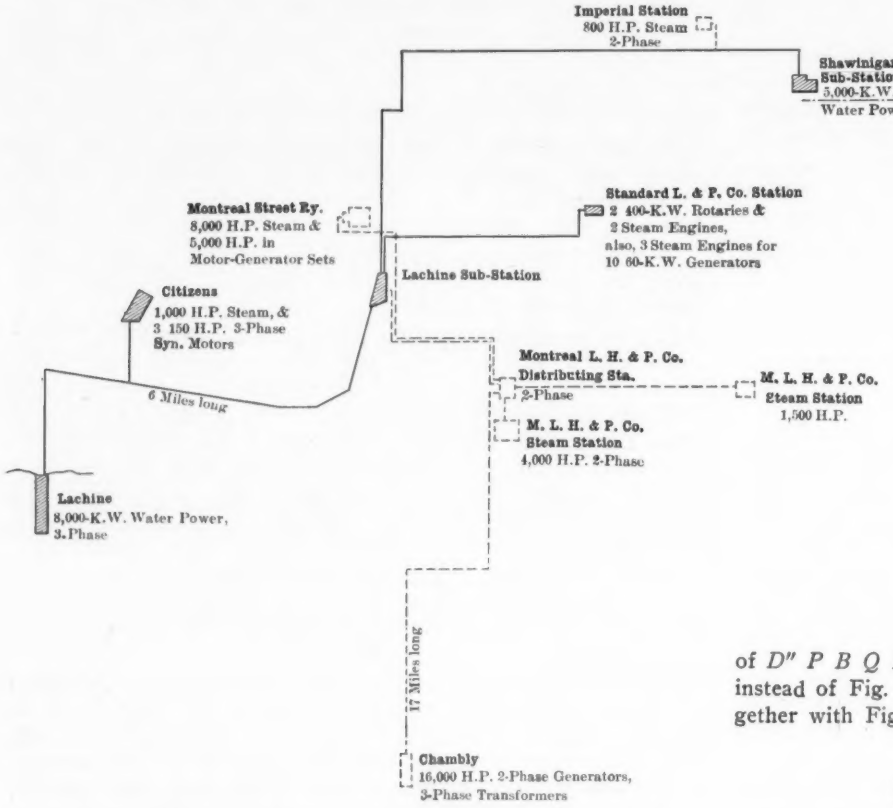


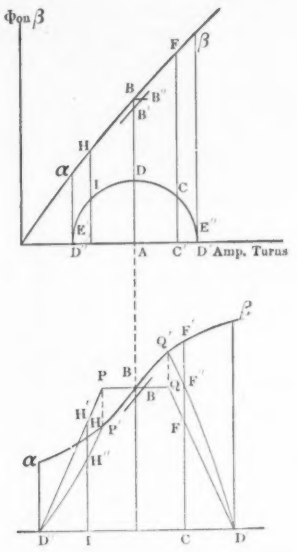
DIAGRAM SHOWING INTERCONNECTION OF THE VARIOUS STATIONS.

Under normal conditions two-phase current is generated at the Chambly works, which is transmitted three-phase at 25,000 volts and distributed in the city on the two-phase system, using the Scott two-phase three-phase system of connections. The Montreal Street Railway Company receives its power from the sub-station of the Montreal Light, Heat & Power Company, operating five induction and one synchronous two-phase motors, which are direct connected to 500-volt, direct-current generators. During the failure of the Chambly dam the 8,000-hp steam power was used entirely and the direct-current generators operating as motors drove the synchronous as well as the induction motors as generators and thus assisted the Montreal Light, Heat & Power Company.

The Lachine Company generate, transmit and distribute their power entirely on the three-phase system. While assisting their competitor the current was transformed from three-phase to two-phase in the sub-station of the latter and connected in multiple with their system. The latest addition of water power supply for the Lachine Company is that from Shawinigan Falls, which is transmitted at 50,000 volts, three-phase, over a distance of 85 miles. The Lachine Company have the control over this power supply for the Island of Montreal, having leased it from the Shawinigan Power Company, and it is expected that inside a few years 25,000 hp will be taken from this source. The Standard Light & Power Company supplies its customers with direct current, receiving its power through two 400-kw rotary converters from the Lachine Company. These rotaries, however, can be also driven by steam engines supplying power to their customers and at the same time assisting the Lachine Company as was the case during the failure of the Chambly dam. Similarly, the Citizens' Light & Power Company, another plant operated by the Lachine Company, assisted by running their synchronous motors as generators driven by steam engines. The whole system worked admirably together without the slightest disturbance.

Predetermination of Characteristics.

In the section of the article by Prof. C. F. Guilbert on the above subject which appeared in the issue of December 20, there are several errors. On page 1003, first column, eighth line, read Fig. 8 instead of Fig. 2. In the fourth line read *D″ H″ B F″ D′* instead of *D″ P B Q D′*. In the second column, twelfth line, read Fig. 7 instead of Fig. 1. Fig. 8 was omitted and is printed herewith, together with Fig. 7, the two figures having a common axis.



FIGS. 7 AND 8.

New German Cable Steamers.

Vice-Consul Harder reports from Stettin: The steamship *Stephan*, recently launched at the Vulcan yards in Stettin for the North German Sea Cable Works at Nordenhamm, is the first vessel built at a German shipyard exclusively for the purpose of cable laying. In the early part of 1903 she will lay out the new transatlantic cable now in construction at the cable works at Nordenhamm. The main dimensions of the ship are: Length over all, 412 ft. 9 in.; beam, 47 ft. 11 in.; depth, 32 ft. 8 in.; draft, 24 ft. 7 in.; tonnage, 4,600 register tons. The whole capacity of the steamer will be 6,050 tons, and she will be able to take 5,000 tons of deep sea and coast cable in four water-tight cylindrical tanks, of which the largest is 43 ft. 4 in. and the smallest 36 ft. in diameter. Two cable engines are fixed on the ship, one for taking in or for repairing a cable already in use and the other for laying the cable.

The Speaking Arc.*

At the meeting February 5 of the Pittsburg local branch of the American Institute of Electrical Engineers, Mr. R. A. L. Snyder presented a communication entitled, "Archophone," and dealing with the speaking arc. The discovery of this property of the electric arc to reproduce speech was first made by Dr. Simon at the University of Erlangen. In the fall of 1897 he found that by making and breaking the current in a circuit paralleling an arc circuit, sounds corresponding to the make and break were reproduced by the arc. Since that time Dudell and Ruhmer have taken up the subject, to which they have added very materially. Dudell shunted the arc with inductance and capacity, and produced the whistling arc. By varying the amount of capacity and inductance he could produce a note of any desired pitch. Ruhmer, following Bell's photophone principle, used a searchlight for transmitting the light waves from an arc lamp to a selenium cell, a telephone receiver and battery being placed in series with the selenium cell. By this arrangement speech can be transmitted for a considerable distance by means of the light waves. The ELECTRICAL WORLD AND ENGINEER of December 20, 1902, contained an article by Mr. A. Frederick Collins describing how Herr Ruhmer transmitted speech by means of light waves to a distance of 12 miles and in a very satisfactory manner. Dr. K. E. Guthe, at the University of Michigan, gave an exhibition of a speaking arc before the University Engineering Society, March 28th, 1902. He claims to have discovered that the sound continues a short time after the arc is blown out.

The lamp exhibited by Mr. Snyder was an ordinary Schuster hot wire arc lamp, working on 110 volts, direct current. In series with the lamp was an impedance coil shunted by an ordinary solid-back transmitter. The lamp and coil were shunted by a condenser. The positive carbon is a special kind, being impregnated with foreign substances to produce a longer and more uniform arc. In the arc formed between ordinary carbons there is a great fall of potential close up to the positive carbon. In the arc formed between impregnated carbons there is a more uniform drop of potential all the way across the arc. Fig. 1 shows a diagram of the circuit.

A number of arrangements have been suggested for the speaking arc circuit, but none with a condenser-shunt, which adds very ma-

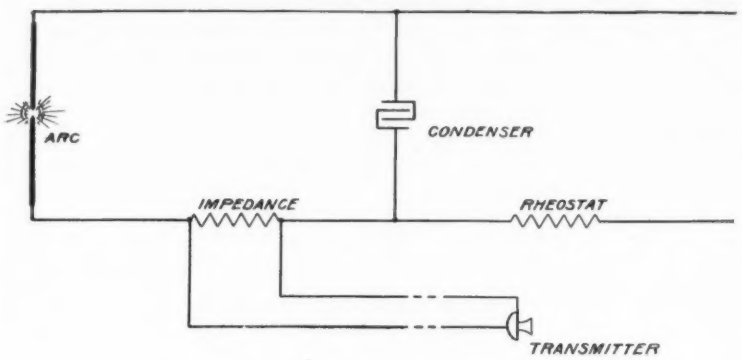


DIAGRAM OF CIRCUIT.

terially to the results. An attempt has been made to make an alternating-current arc reproduce speech, and though the results were reasonably good, it sounded as if the speech were confused with the notes of a jew's harp.

Several theories have been advanced as to what causes these sound waves to issue from the arc. The most logical explanation appears to be the one assigning the cause to the sudden expansion and contraction of air due to variations in the temperature of the arc. In speaking into the transmitter the sound waves strike the diaphragm, causing the current to pulsate in the transmitter circuit, and this pulsating current sets up similar pulsations in the arc circuit. The temperature of the arc varies as the square of the current passing through it. As the arc is composed principally of carbon-vapor in a high state of molecular vibration, it has a very low specific heat. The temperature of this vapor varies almost instantly with the current. When the current is pulsating, the temperature of the arc is raised or lowered correspondingly, and the volume of vapor is increased or diminished in accordance with its temperature. Hence the volume of the vapor increasing and diminishing sets up sound waves in the surrounding air.

This discovery may be utilized in the near future to enable a speaker to address great audiences with but little effort. This can be done by the speech waves from a transmitter circuit being impressed upon the field of an arc light generator. All the lamps supplied by this machine will reproduce the speech. Besides being of use in addressing large audiences and transmitting wireless telephone messages, the value of the archophone as an advertiser is obvious. Thunder, one of the loudest known sounds, is produced by the electric arc.

* A paper read at the 4th meeting of the Local Branch of the American Institute of Electrical Engineers, held at Pittsburg, Pa.

Some Recent Electrical Patents.

During the past several months ten patents have been issued to Albert G. Davis covering a considerable range of invention. Six of the patents relate to phase transformation, the applications having been filed June 25 and September 28, 1897. The other four have as subjects a rotary transforming device, a variable-speed,

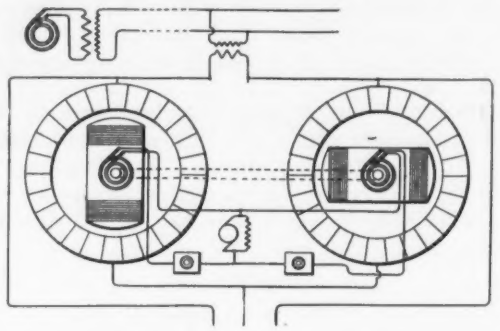


FIG. 1.—CONVERTING SINGLE-PHASE CURRENTS TO POLYPHASE CURRENTS.

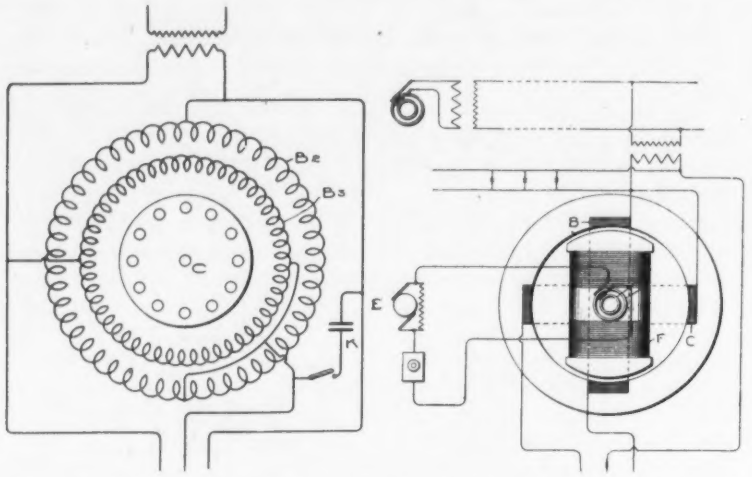
direct-current motor, a frequency compensating means for electric meters and a regenerative system for electric traction, the dates of application being respectively May 26, 1900; March 29, 1902; March 29, 1902, and May 21, 1900.

In one of the methods described for converting from single to polyphase, two synchronous motors (Fig. 1) have their direct-current members, which are the revolvable parts, connected together rigidly at an electrical angle of 90°. The two legs from a single-phase circuit form the outer sides of a two-phase circuit. Connection with one of these legs is made to the primary of one motor and with the other leg to the primary of the second motor; opposite these connections, both motor windings are tapped and a common connection made to the conductor forming the third conductor of the two-phase circuit. Another method is illustrated in Fig. 2, where B_1, B_2 are two angularly displaced windings on a single core, connected in series as shown. C is the secondary member, consisting of a short-circuited rotor. When once started the device will run as a single-phase induction motor, but as the two windings are dephased, they will form part of a polyphase system. The condenser, K, is used in starting.

Still another form is shown in Fig. 3. E is the exciter of the field, F, which is driven at synchronous speed or by the action of the resultant field of B, C. B and C are two coils at right angles connected as shown with the single-phase source and the polyphase circuit. A modification of the latter (Fig. 4) consists of a stationary member with a short-circuited winding, and a revolvable member with four salient poles. The four coils on these poles are interconnected and also connected to four collector rings; two of the latter are connected to brushes from which two sides of the polyphase circuit proceed, the other pair of brushes being connected to the single-phase source. Another patent shows a still further modification in which there is a common short-circuited member and two separate structures carrying the phase-displacing windings, and a third structure carrying the inducing windings. The patents describe details of starting. The advantage claimed for this method of phase transformation is that any change in the load of the secondary system will, at most, produce a corresponding change in each of the secondary circuits and will not affect their relative phase angles. An adjustment of the phase relation of the e.m.fs induced in the secondary system is provided.

The patent entitled "Rotary Transforming Apparatus" relates to a rotary converter which admits of any desired ratio of conversion. Referring to Fig. 4, which shows a converter with a revolvable field, the essential features are the double magnetic elements of the stationary part, one carrying a primary winding connected with the polyphase source, and the other a secondary winding connected with the commutator. Means are provided for varying the length in circuit of the primary coils, thereby varying the direct-current voltage. The patent describes the principle applied to a stationary field and rotating primary and secondary coils.

The variable-speed electric motor, which forms the subject of a patent, is of the class for driving machine tools, printing presses,



FIGS. 2 AND 3.—CONVERTING SINGLE-PHASE CURRENTS TO POLYPHASE CURRENTS.

etc. A small motor-generator is employed of about one-tenth the capacity of the working motor. The latter is of the ordinary direct-current type and by means of its controller first takes current from the motor-generator; after a predetermined speed is reached the motor is connected directly to the line and the motor-generator stops running. The controller gives 13 speeds, of which five are with the motor-generator in circuit—the control of the main motor being through armature and field rheostats.

The patent on frequency-compensating means for electric meters relates to the use of a circuit containing capacity and inductance

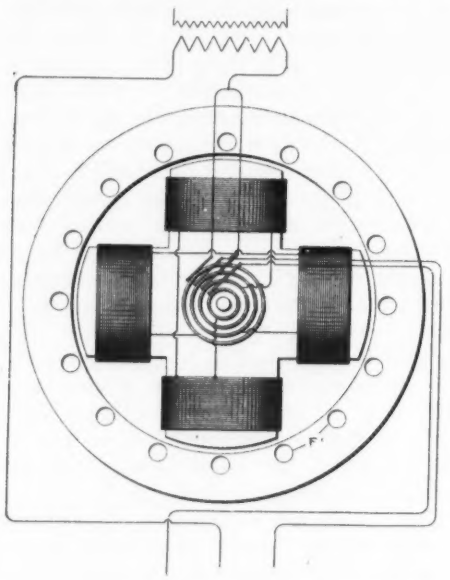


FIG. 4.—ANOTHER FORM OF ROTARY CONVERTER.

whereby changes in frequency are compensated for. For the normal frequency the capacity and inductance have such a relation that there is no compensating effect. If, however, the frequency changes either above or below normal, their relative effect is altered, the inductance preponderating upon rise of frequency and the capacity upon fall of frequency. This circuit is shunted about one of the meter current coils, and the difference of phase which it may produce with respect to its companion coil results in a correcting torque on the damping disc.

The regenerative system patented is particularly adapted for use with modern high-speed motor cars or trains employing a number of motors. Its principal object is to return to the supply line energy when the car or train is being retarded. Another application is in starting a car or train from a station without the resistance ordinarily carried for the purpose of varying the e.m.f. impressed on the motor circuit. Three additional contact rails are required on the track, and certain apparatus located at one or more points along the line. In one modification this consists of an alternating-current motor-generator set, the field of the direct-current generator being

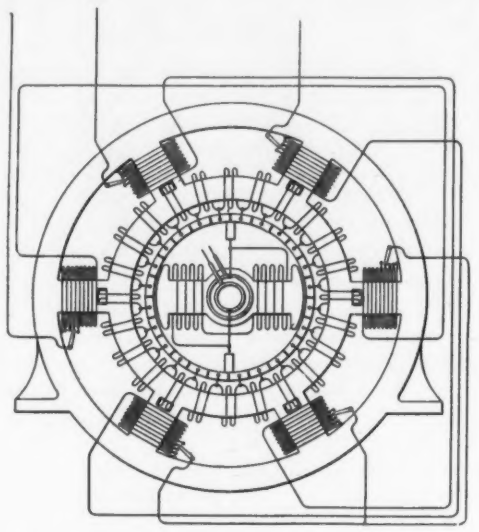


FIG. 5.—CONVERTER WITH REVOLVABLE FIELD.

varied by electrically-operated means at the fixed point and controlled from the moving vehicle. To maintain a constant feed for the car-motors when acting as generators, a shunt-wound generator is mechanically coupled to the motor-generator. A storage battery might be substituted for the latter. This combination permits of the transformation of the constantly-diminishing e.m.f. generated by the motors of the vehicle, acting as generators, into a practically constant e.m.f. counter to and greater than that of the line, so that a current will continue to flow from the generators on the cars to the line until the car is brought almost to a full stop. The function of the shunt-wound generator or storage battery is to keep the fields of the car motors practically constant, independent of the line voltage, while the motors are acting as generators. The trolley or third rail is required to be divided into sections, an advantage of which is that with the present arrangement there can be no collision with a car standing still at a station.

New Telegraph Competition.

News from the West states that immediate competition with the Western Union and Postal Telegraph Companies in commercial business, and ultimately competition with both of those companies in general telegraph business is the purpose of a new telegraph company which has been organized quietly in the interest of St. Louis and Chicago capitalists.

Absorption of all leased lines which may be released at lower rates, the use of their lines for telephone purposes, which it is declared will bring all of the independent lines in the territory covered by the new company into Chicago, and an attempt to control all the Board of Trade and stock exchange business in the West, are further intentions of the concern.

The work of the new company has progressed so far that the promoters have already secured options on the Chicago & Milwaukee Telegraph Company, operating between Chicago and Milwaukee, the National News Telegraph Company, an Illinois corporation, and a short line which now enters St. Louis.

The Orthwein family of St. Louis is credited in dispatches from that city with the promotion of the deal, and they, with their associates in Chicago, whose names have not yet been given out, will endeavor to furnish a complete commercial service between Milwaukee, St. Louis, Chicago and Kansas City.

The Construction of Aerial Telephone Lines—IV.

BY ARTHUR V. ABBOTT, C. E.

COST OF OPEN WIRE LINES.

THE cost of constructing open wire telephone lines is probably the most difficult item to estimate of all the various parts of the telephone plant. This is partly owing to the absence of any real and definite standard type of construction and partly to variation in prices that obtain in different parts of the country for the various materials used. The city line must be built to carry a greater number of wires than is usually necessary in cross-country lines, and must be designed with the view, ultimately, of carrying perhaps several aerial cables. In addition to greater strength, city lines must present a much better appearance than is demanded in country work. Wages and price of materials in cities are often considerably higher than in country districts. Rights of way are more expensive and more difficult to obtain, and greater delays are frequent during construction. For such reasons the city line is considerably more expensive

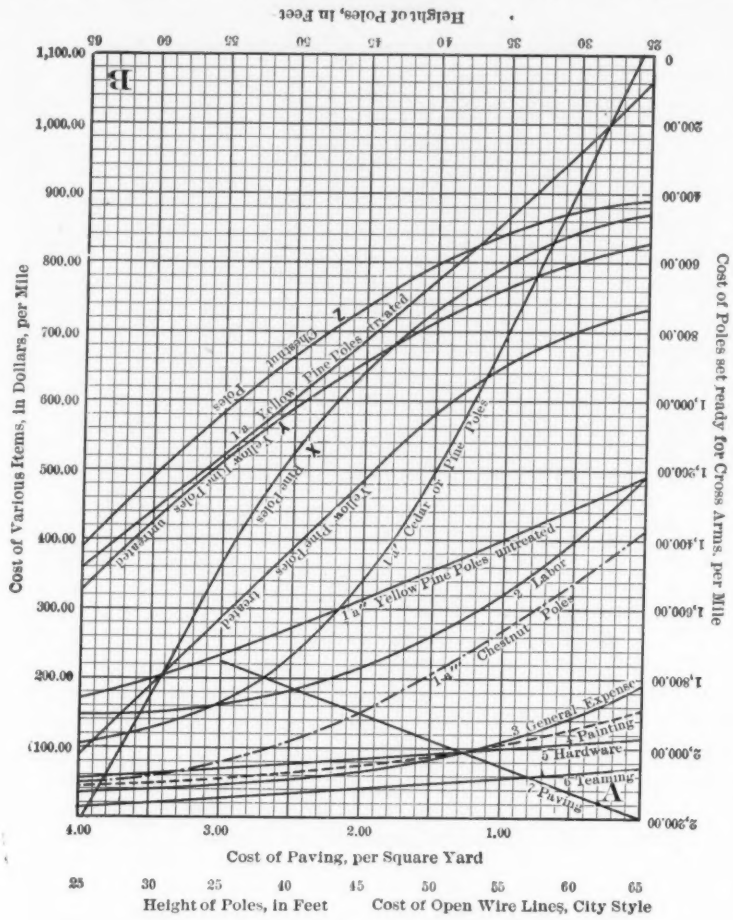

Height of Poles, in Feet
Cost of Various Items, in Dollars, per Mile
Cost of Poles set ready for Cross Arms, per Mile
Cost of Paving, per Square Yard
Height of Poles, in Feet
Cost of Open Wire Lines, City Style
1 Cost of Poles
2 Labor
3 General Expense
4 Painting
5 Hardware
6 Teaming
7 Paving
1A Yellow Pine Poles, Creosoted
1A' Northern Pine or Cedar Poles, Creosoted
1A'' Yellow Pine Poles, Uncreosoted
1A''' Chestnut Poles
1 and 2 Yellow Pine Poles, untreated
1 and 2 Chestnut Poles
1 and 2 Yellow Pine Poles, Creosoted
1 and 2 Cedar or Pine Poles
A
B

FIG. I.—TABLE OF DATA FOR ESTIMATING COST OF POLE SETTING.

than that constructed in the country. The chief items composing open wire line cost are poles, cross arms with pins and insulators, wire and labor of erection. To aid in the estimation of open wire costs six tables in graphical form are prepared. Table 2 gives the cost of single poles, and the cost per wire mile of various sizes of copper wire (at various prices of copper per pound) erected in place including cross arms, hardware, pins, insulators and labor of erection. Holding this table with the point *A* in the lower right-hand corner, a scale marked "Pole Cost in Dollars" is found on the left hand. On the bottom there are two scales reading from 25 to 65 in both directions denominated "Height of Poles in Feet." In the body of the table there are nine curves, *A, B, C, D, E, F, G, H* and *I*, by means of which the cost per pole of various kinds, sizes and lengths can be calculated. The kinds of poles to which these curves apply are as follows:

A Southern cedar, delivered in Northern States, 7-in. top, best quality.

B Northern pine or cedar, 8-in. tops, delivered in Middle Western States.

C Southern cedar, 7-in. tops, delivered in Northern States, ordinary quality.

D Chestnut, 7-in. tops, delivered within wagon haul of point of cutting.

E Southern cedar, 6-in. tops, delivered in Southern States.

F Yellow pine, 7-in. tops, delivered in Northern States, untreated.

G Yellow pine, 8-in. tops, delivered in Northern States, untreated.

H Yellow pine, 7-in. tops, delivered in Northern States, creosoted.

I Yellow pine, 8-in. tops, delivered in Northern States, creosoted.

Example: To find the cost of a chestnut pole 40 feet high, 7-in. top, a vertical from 40 on the lower scale to Curve *D*, thence a horizontal to the left-hand scale finding $3.40. The "Height of Poles," scales should be read from left to right for Curves *A* to *E* inclusive, and from right to left per curves *F* to *I* inclusive.

By turning the sheet around so that the point *B* is in the lower right-hand corner, the curve per cost of wire can be read. The lower horizontal scale is "Price of Copper per Pound," and should include delivery at nearest railway stations. The left-hand scale is "Cost per Wire Mile for Wire, Pins, Glass and Cross Arms erected." Carriage bolts, lag screws, braces, etc., are included and labor of stringing, putting up and tieing. Two sets of curves are given, one set for copper wire and from No. 6 to 14 inclusive B & S gauge, indicated by full lines, and one set in dotted lines for Nos. 7, 8 and 9 B. W. G. The best quality of standard ten-pin yellow pine cross arms (untreated, but painted) is assumed. If common pine arms are used, deduct $3.75 from the cost of any mile of wire. Thus the cost of a mile of No. 8 B. & S. wire at 14 cents per pound is found by following a vertical from 14 on the lower scale to the curve headed No. 8, B. & S., thence a horizontal to the left-hand finding $43.80. If common arms are used deduct $3.75, giving $40.05 per mile.

Tables 1 and 3 contain the data for estimating cost of poles set, ready for cross arms and wire. Table 1 is calculated for city lines and Table 3 for country lines. Holding Table 2 with *A* in the lower right-hand corner, the lower scale is "Height of Poles in Feet," while the left-hand scale gives the expense of the various items comprised in the cost of a mile of poles ready for arms. These curves are based on wages at $1.75 per day, and $3.25 per day for teaming. The expense of poles set, ready for arms, is divided into 7 parts.

1st. The Cost of Poles.
2nd. Labor.
3rd. General Expense.
4th. Painting.
5th. Hardware.
6th. Teaming.
7th. Paving.

Curves *1A'*, *1A''* and *1A'''* give the total cost per mile for poles only. Curve *1A* shows the cost of creosoted yellow pine poles, *1A'* northern pine or cedar, *1A''* yellow pine poles uncreosoted and *1A'''* chestnut poles. Curve 2 gives the labor expense. This includes pole inspection at point of delivery, shaving, framing and other carpenter work to prepare the pole for setting; labor of loading and unloading from teams; the removal of pavement and digging the necessary holes; the refillment of the hole and tamping of the pole after setting and the temporary replacement of the pavement. Curve 3, "General Expense," includes all items which cannot be properly classified under any of the other headings, such as cost of supervision, car fares for workmen employed, office expenses, etc. Curve 4 is devoted to painting, giving the cost of painting the poles two coats of lead in linseed oil with a coat of black paint, 6 feet high from the ground. Curve 5, headed "Hardware," is the cost of pole steps, protection strips, butt guards, wheel guards, etc., etc. Curve 6, headed "Teaming," is the cost of all teaming, including hauling of poles, tools, machinery, etc., to and from the line location. Curve 7, headed "Paving," gives the cost of necessary repaving around the excavation made in which to place the pole. As the cost of paving is itself variable, this curve must be read by aid of the supplementary horizontal scale, headed "Cost of Paving per Square Yard." The prices on this scale run to $3, and the cost of repaving per mile of poles is found by taking the cost of paving per yard on the lower scale, following a vertical to Curve 7 and thence a horizontal to the left-hand scale. For example, at $2 per yard the cost of paving for one mile of poles is found by following a vertical from $2 on the lower horizontal scale to the Curve 7 and thence a horizontal to the left-hand scale, finding $150. By inverting Table 2 so that *B* appears in the lower right-hand curve a set of four summation curves are found

showing the complete cost of all the preceding items per mile of poles set ready for arms. Four curves are given—*W X Y* and *Z*—

to find the cost of a mile of poles, ready for cross arms, select the height of the pole on the lower horizontal scale, follow a vertical

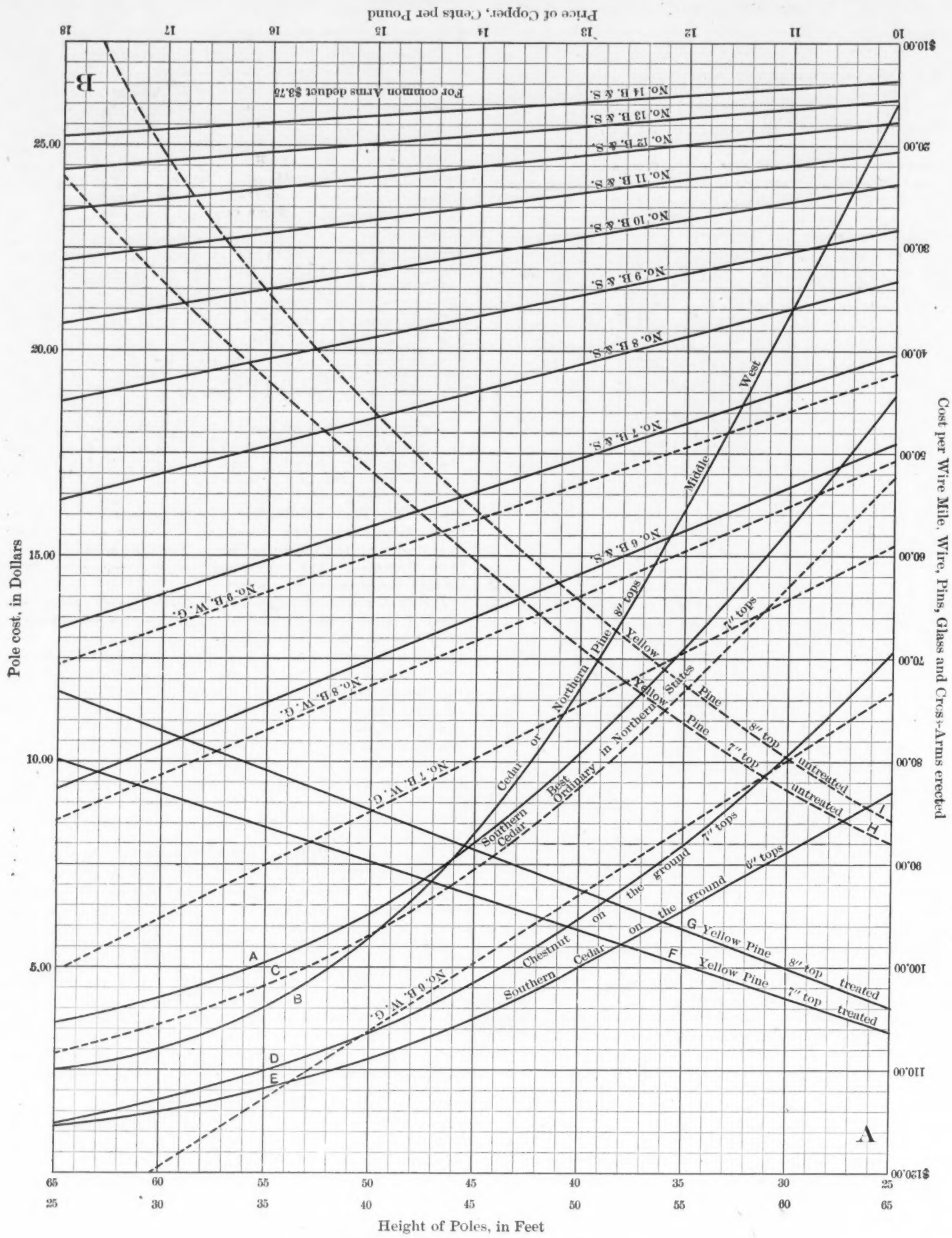


Fig. 2.—Table Showing Cost of Poles, Wires, Etc.

respectively, applying to yellow pine poles treated, northern pine or cedar, yellow pine poles untreated and chestnut poles. For example,

till the curve of the kind of pole to be used is found, and thence a horizontal to the left-hand scale. Thus a mile of 50-ft. poles of

yellow pine, creosoted, will cost $1,412; of northern pine, $1,148; of yellow pine, untreated, $1,024; of chestnut, $868.

Table 3 is arranged in precisely the same manner but applies to country style pole lines. Holding this table with *A* in the lower right-hand corner, the lower scale is "Height of Poles in Feet" and the left-hand scale "Cost of various items in dollars per mile." For country lines there are only four items:

1. Poles.
2. Labor.
3. Teaming.
4. General expense.

Curves for two varieties of poles, 1*A* northern pine or cedar poles and 1*A'* chestnut poles are given. Curve 3 gives the labor cost,

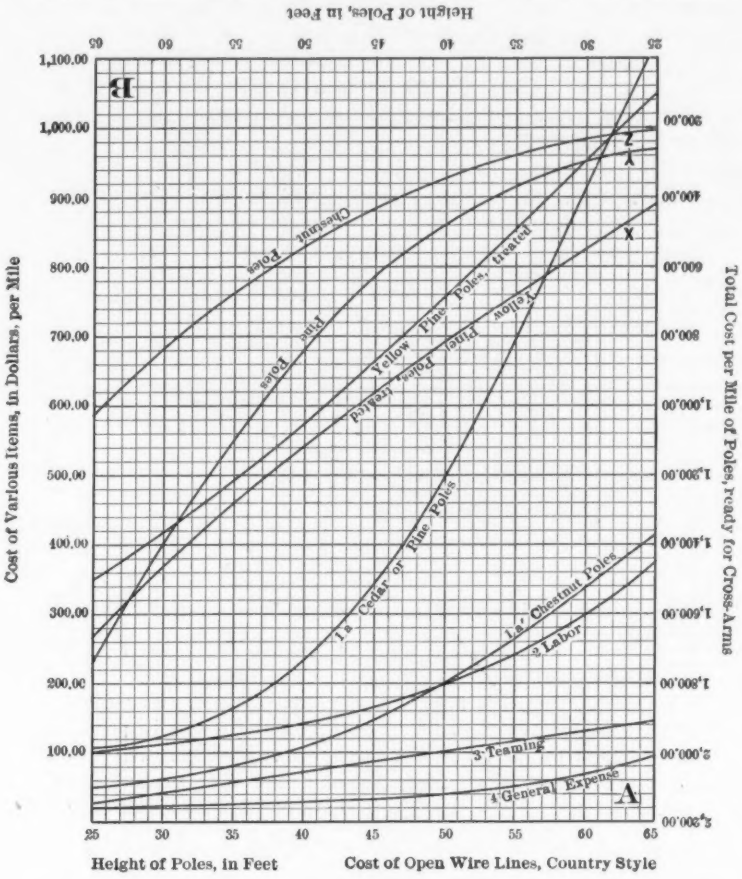


FIG. 3.—DATA FOR ESTIMATING COST OF POLES SET FOR CROSS ARMS, ETC.

Curve 3 that for teaming and Curve 4 the general expense, and for these the same explanations apply as have been already given for Table 1. By inverting Table 3, so that *B* is in the lower right-hand corner, the total cost per mile of poles, ready for cross arms, is found. Three curves are here given—*X*, *Y* and *Z*—applying respectively to lines constructed of yellow pine treated, northern pine or cedar and chestnut poles. Thus a mile of 45′ chestnut poles is seen to cost $428, a mile of 45′ pine poles $628, and a mile of treated yellow pine $960.

The information thus presented in Tables (Figs.) 1, 2 and 3 will enable the reader by selecting such items as may be desired to calculate with great rapidity and by means of a few simple additions the cost of almost any kind of open wire line in any location.

Nebraska Independent Telephone Interests.

The managers and superintendents of the independent telephone exchanges in the southeastern part of Nebraska held a meeting in Nebraska City on February 7 and organized the Southeastern Nebraska Telephone Association. The object of the association is to bring about a system of uniform rates over all of the independent lines in that part of the State. The following officers were elected: A. E. Gantt, Falls City, president; T. H. Pollock, Plattsmouth, vice-president; A. M. Munn, Nebraska City, secretary. The three officers, with J. C. Killarney, of Auburn, and C. N. Kadus, of Stella, will compose the Executive Committee. The next meeting of the association will be held at Falls City.

Cooper Hewitt Interrupter.

EACH advance of wireless telegraphy has emphasized the inefficiency of the spark-gap interrupter, and this element has threatened to be the weak factor in the commercial development of aerial transmission. In the Marconi transatlantic experiments the power required at the disruptive gap was enormous in comparison with the presumable quantity of energy radiated from the antennæ, and a serious incident of the great local disturbance thereby set up has been the adverse effect on telephonic service over a wide range, which forecast trouble for the exploiters of commercial wireless telegraphy. It is, therefore, a matter of unusual interest to learn that an interrupter for an oscillating circuit has recently been devised which not only very greatly reduces the draft on the source of electrical energy but possesses most valuable properties with respect to exact control, and at the same time is extremely simple in form and application.

In wireless telegraphy the spark-gap oscillating circuit has heretofore been employed, either in connection with the simple induction coil or the disruptive gap. In his studies on the mercury vapor tube, it occurred to Mr. Peter Cooper Hewitt that the "electric valve" property of the vapor tube, which property he has employed in his static converter, could be applied to the oscillating circuit. This application he has succeeded in carrying out in a most successful manner.

Briefly stated, the spark-gap of the oscillating circuit is replaced by a mercury vapor tube in parallel with a condenser. Assuming that the immediate source of electrical energy is a transformer, in the transformer secondary in series are a condenser and the primary of the antennæ-ground circuit, the condenser being shunted by a vapor tube. The tube does not differ in principle from the usual Cooper Hewitt vapor tube, though naturally of a somewhat different form, owing to its different application, and the nature of the work to be performed. The transformer secondary voltage may range between 10,000 and 20,000 volts.

The fundamental advantage of this interrupter is the enormous speed of interruption that may be attained, and the absolute control of this speed. Moreover, by proper design and adjustment, any given rate of interruption can be secured. With the disruptive spark there is a limit to the efficient rate of interruption fixed by the time required for the condenser to clear itself, and this rate, as well as the total effect, is variable, owing to the mobility of the arc, the condition of the knobs with respect to polish, etc. This latter consideration does not apply to the mercury electrode surface, and the vacuum discharge is not subject to similar fluctuations. It follows that with this new type of interrupter it is possible to create and maintain continuously oscillations of an absolutely definite character, the great importance of which consideration with respect to wireless telegraphy is obvious.

The practical advantages of the interrupter are no less evident. The efficiency is very high, the loss being about proportional to the drop of about 14 volts in the tube, and in a circuit of 10,000 volts this amounts to a but small fraction of one per cent. The device, consisting merely of a glass tube or bulb with sealed-in electrodes, is inexpensive, and in case of breakage can be immediately replaced by another in the same manner as an incandescent lamp.

Telephony in Washington, D. C.

The long-standing trouble between the Bell telephone system and the local subscribers in Washington, D. C., has been satisfactorily settled by General Manager Bethell, whose régime has been marked by a noteworthy improvement all along the line. The Subscribers' Association will drop all its 100 suits against the Chesapeake & Potomac Company as to rates and grades of service and will receive $10,000 to offset its claims. The company agrees also to rebate half of the suspense accounts, making another $10,000, and the question of new rates is left for the future development to determine. Mr. Bethell has announced that the plans of improvement for the next two years involve the expenditure of about $1,000,000. Out of the 2,000 subscribers in Washington, the burden of the fight had been borne at last by only 200, and all the commercial interests of the District have recorded their support of the arrangement and of the progressive attitude of the company.

New Telephone Patents.

If the necessity for an article may be judged by the number of patents providing for it, then surely the need for some antiseptic screen, gas or solid, for telephone instruments is very great. Indeed, with the patent issues as a criterion, by this time a large proportion of the population should be suffering from some disease "transmitted by telephone." Fortunately, this telephone infection seems to be largely an output of the imagination; nevertheless, the inventors of antiseptic appliances go right on with their work, the latest production being a form of the "sheet-of-paper" type of protector embodied in a patent issued to S. G. Ballard. This device is a holder for sheets of paper arranged to clamp upon the transmitter so that a fresh sheet may be dropped in front of the mouthpiece before each conversation. The patent is chiefly concerned with details of construction, but it is rather interesting to note in the specification that the inventor lays almost as much weight upon the value of the sheets of paper as advertising space as upon their antiseptic value.

In two patents issued to Mr. Edward E. Clement, of Philadelphia, there is an interesting application of the coherer to "wire" telegraphy and other long-distance signaling, such as telephone calling signals. In this system a coherer of large current-carrying capacity and of a very high normal or decohered resistance is so related to the line that it serves directly as the controlling switch or contact of the local signal apparatus, when acted upon by a high potential discharge, received either directly or indirectly from the distant station by means of the main line wires. In one patent the use of such a system at common battery subscribers' stations in lieu of the usual condenser, is described, while the other patent deals with the general application of this method of signaling.

Considering the latter patent first, Fig. 1 will illustrate the general principle, this showing one of the many ways of using the system which have been devised by the inventor. Here C^1 represents the coherer, preferably a glass tube containing rather large-sized iron and nickel filings, mixed. The wires of the main line are represented by 1 and 2, while the local circuit is 25, b' L, 24, V. When the key, K, is depressed a current flows through the local and line circuits in series, thereby magnetizing the core in U. When the key is released the discharge of the electromagnet is

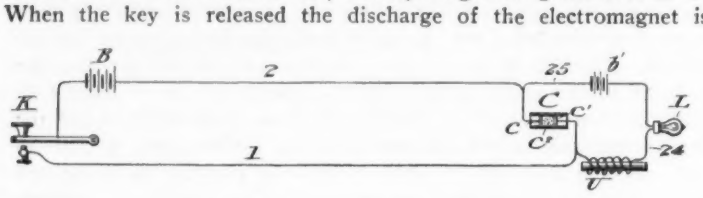


FIG. 1.—CLEMENT SIGNAL SYSTEM.

sufficient to cohere the particles of C, when battery, b' operates the local signal. When this local signal is a telegraph sounder, the decoherence will be accomplished by the sounder. When, however, the signal is a telephone switchboard line lamp, Mr. Clement proposes to operate a tapper in connection with the switchboard jack, mounting his coherer, for this purpose, immediately below the jack in such a manner that the insertion of a plug will operate the tapper.

In the use of the coherer in lieu of the subscribers' station condenser, the former is associated either directly or indirectly with the hook switch, or is mounted upon the magneto bell frame. It is wired directly in series with the ringer, the two being then bridged across the line. The normal twenty-odd volts direct current of common battery practice is not sufficient to cohere the filings, and decohered their resistance is said to be about one-tenth megohm. When, however, the alternating ringing current of seventy volts is applied to the line, the resistance of the coherer is reduced to forty ohms and the bells ring. The act of removing the receiver from the hook switch or the operation of the ringer armature, according to arrangement, shakes the coherer and decoheres it.

It is difficult to state with certainty the future of such a novel system, but it may be said with safety that a great deal of refining will be necessary before the coherer will be applicable to telephone working with even a small fraction of the reliability of the relays and condenser it attempts to supersede.

As a means of reducing the mutual capacity of the wires of a telephone line run in cable, Mr. R. F. Hall has devised a paper spacer to be wound with the wires of a telephone cable, having twisted pairs according to usual telephone cable practice. In this cable the paper spacing strip is corrugated transversely so that it forms a connected series of U's. The bottoms of these are cemented to a paper backing strip, somewhat wider than the U strip. When the paper-insulated wires are to be twisted in pairs, they are placed one on each side of the corrugated strip, lying in the corners between it and the backing strip. By this means the backing strip serves, after twisting, to hold the several parts together, while the spacing strip holds the wires apart. Mr. Hall has assigned his patent to the Western Electric Company.

In a patent granted to C. H. Thordarson, of Chicago, an improvement in telephone magneto bells is described. This improvement consists in making the polarizing magnet of two parts, held together by a clamping screw passing through an elongated hole or slot in one of its portions. By this means the length of the polarizing magnet may be varied, this in turn varying the air-gap between the free pole and the armature, and thus facilitating adjustment of the polarizing field.

A "Telephone Transmitter" is the subject of a patent issued to Frank S. Tucker, of Boston, and assigned to the Electric Gas Lighting Company. The improvements described are mechanical in nature and may be best described by reference to Fig. 2. The bridge piece which supports both the diaphragm and button has upon its ends projections, d, which are adapted to engage in a

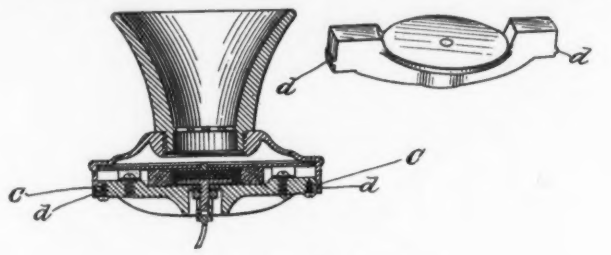


FIG. 2.—TUCKER TRANSMITTER.

groove, c, in the transmitter front. In assembling one end of the bridge piece is inserted in the groove, when the other is pressed in position through a slot provided for that purpose. The case is then given a part revolution, thereby locking the whole in position.

The last patent of the issue of February 10, relating to telephony, is entitled "Telephone-Protecting Device," and has been granted to G. R. Bonham. This apparatus consists of the equivalent of a knife switch to be inserted in a telephone line just before the subscriber's premises is reached. This switch has no hinge, and the blades are so shaped that when locked together manually the main line wire pulling one way, and the subscriber's wire pulling the other, will be insufficient to cause the switch to open. A cord is, however, extended through the house wall to the telephone instrument and in case of a storm coming up the blades may be separated by an additional pull put upon the cord. This device will certainly open the circuit wide enough, as the wires will fall to the nearest support; but after the storm—"Who will put them up again?"

Ohio Independent Telephone Companies.

A meeting of representatives of independent telephone companies of Ohio was held in Cleveland on February 7 for the purpose of establishing a more potent "Community of Interests" among themselves. An organization was effected under the name of the Independent Telephone Traffic Company of Ohio. Membership will be limited to the heads of independent telephone companies, and no member will be permitted to own more than ten shares.

It is explained by one of the most active promoters of the new concern that it will be a straight business enterprise. The company will, among other things, purchase for its members supplies of various kinds, and although this branch of the business has not yet been fully organized, it is not intended that it shall interfere with the business of manufacturers of telephone apparatus or construction material. Among other advantages offered by the association will be the employment of engineers for the purpose of working out uniformity of practice and construction. There will be a central clearing house for toll business, and each company will receive its pro rata of the receipts for the business passing over

its lines. A department will be maintained for the distribution of information to members, and a "bad debt exchange" will also be established.

There were present at the meeting representatives of 47 companies. It is thought that a large majority of the independent companies in the State will become members of the association. The first meeting will be held in Cincinnati some time during May next. A press committee will be formed for the purpose of giving out such information relative to the meetings as shall be deemed advisable by the officers.

The following officers were elected at the organization meeting: President, W. Gilbert Thompson, Lebanon, Ohio; first vice-president, Judge Crissinger, Marion; second vice-president, H. C. Devin; treasurer, A. V. Hageman, Lorain. The directors are G. P. Thorpe, F. L. Beam, Carl Curtiss, R. E. Hamblin and H. H. Robinson.

CURRENT NEWS AND NOTES.

CHICAGO ELECTRICAL ASSOCIATION.—At the meeting of the Chicago Electrical Association on February 20, in the Monadnock Building, Mr. H. H. Brinckerhoff, general manager of the Metropolitan West Side Elevated Railway Company, of that city, is to discuss third-rail methods, with illustrations.

OFFICIAL WIRELESS TELEGRAPHY IN FRANCE.—A special cable dispatch from Paris of February 9 says: The *Journal Officiel* publishes a Presidential decree stating that the Department of Posts and Telegraphs alone is authorized to work the wireless system of telegraphy. Individuals desirous of working such a system must obtain permission from that department.

OERLIKON INDUCTION MOTOR WITH FOUR SPEED VARIATIONS.—In the article with the above caption, which appeared in the issue of January 17 several errors occur. The author of the article is Dr. Hans Behn-Eschenburg, not Hans Behr. On page 113, first column, second line, the normal speed of the motor should be 1,450 r.p.m., not 450 r.p.m., as printed. Finally the table at the foot of the first column, page 113, refers not to the induction motor described, but to a direct-current motor.

A REDWOOD WATER TUNNEL.—The Niagara Falls Power Company has contracted for 3,000,000 feet of redwood timber, to be delivered at Buffalo, N. Y., next July. The redwood is to be used instead of steel for a large tunnel to be constructed next summer. The reason given for the preference of the California wood is that water passing over it continuously forms a surface of a soapy and pasty nature, which is proof against corrosion, whereas the particles of sand and matter carried with great velocity from the Niagara River cut into and destroy steel in an incredibly short space of time.

CLEVELAND GAS PLANT.—At Cleveland, Ohio, on February 9, at the meeting of the Board of Control, the first step toward the establishment of a municipal lighting plant was taken by Mayor Johnson. The ordinance was approved providing for a Division of Lighting and the appointment of a superintendent, inspectors and men to care for the lamps. Places for about 200 men are provided. When the present lighting contracts expire the city will own all the street lamps and natural gas may be substituted for artificial gas. It is admitted that this is a movement toward municipal control

HENRY A. ROWLAND MEMORIAL LIBRARY.—In order to establish a permanent memorial of the late Prof. Rowland, and to promote the efficiency of the physical laboratory of the Johns Hopkins University, one of its former students has given a most generous sum of money with which to found a special collection of books, pamphlets and other publications in the field of radiation and spectroscopy. This is to be called the "Henry A. Rowland Memorial Library," and is to be placed in the physical laboratory of the University. To make the collection complete and to maintain its usefulness, the co-operation of observatories, laboratories and investigators is necessary. It is hoped that sets of official publications, books, reprints of papers on spectroscopy or allied subjects, and photographs of spectra and of apparatus will be contributed to the library, both now and in the future. They may be addressed to the care of Prof. Joseph S. Ames, at the University.

AMERICAN ELECTROCHEMICAL SOCIETY.—The following gentlemen were elected to membership in the American Electrochemical Society at the February meeting of the council: L. Seeger, New York; Dr. Rudolf de Neufville, Frankfurt-on-Main, Germany; Dr. Hans Landolt, Turgi, Switzerland; J. M. Morehead, Chicago, Ill.; W. Smith Horry, Niagara Falls, N. Y.; C. I. Zimmerman, Madison, Wis.; John W. Schlegel, New York; Craig R. Arnold, Sharon Hill, Pa.; A. J. Rodgers, Milwaukee, Wis.; O. M. Thowless, Newark, N. J.; Godfrey L. Cabot, Boston, Mass.; Joseph B. Hall, Chicago, Ill.; Francis W. Higgins, Niagara Falls, N. Y.; Robert S. Allyn, New York; Ralph McNeill, New York; Takakichi Nakayama, Kochi, Japan.

NOVEL ISOLATED PLANT ENTERPRISE FOR PITTSBURG.—An extension of the usual scope of office building power plants is to be tried in Pittsburg under the direction of Henry Phipps. A group of office buildings will be erected in lower Pittsburg in the neighborhood of Fifth Street and Duquesne Way, and one plant will furnish light, heat and power for the entire group of five or six buildings, including the Bessemer Building, corner Sixth Street and Duquesne Way. The power equipment has already been partly contracted for and will include two 1,500-hp Westinghouse-Corliss engines, which are now under construction, and will be ready for delivery in about six months. These engines are of the horizontal, cross-compound type, and will operate non-condensing, the exhaust steam being used for heating purposes. On account of the difficulty of high river water, universally experienced in Pittsburg, the engines will be placed upon the ground floor instead of the basement, while the boilers will be located on the second floor of the plant and supplemented by suitable coal and ash-handling appliances. The machinery will be installed by Westinghouse, Church, Kerr & Co.

PARCEL ELECTRIC RAILWAY.—A patent issued February 10 to Thomas E. Murray and John Van Vleck describes an interesting automatic electric railway system for the conveyance of parcels, mail, etc. There may be any number of stations disposed at intervals along the main track, a given car being automatically side-tracked at a desired station. Very complete provision is made to insure the continuity of the general service in case of any derangement of action of a car, switch or other detail. The construction and arrangement is such that, first, a car starting from a principal depot or any given station will automatically proceed to and stop at any other given station; second, prior to reaching the predetermined station said car will automatically close a switch for leading it upon the station siding; third, prior to reaching the predetermined station the strength of the current actuating the car will be automatically reduced; fourth, prior to reaching the predetermined station an electric brake mechanism will be automatically applied to retard the motion of the car; fifth, the line conductors in proximity to the track are disposed in block sections, and by means of suitable automatic mechanism the section next to and immediately succeeding that upon which the car is advancing is rendered dead, so protecting the car from rear collisions; sixth, the car mechanism being adjusted for a predetermined or normal speed any excess speed will result in the automatic operating of mechanism to reduce the speed to normal; seventh, in event of the automatic switch-controlling mechanism not properly setting the switch the car is automatically arrested before the switch is reached and cannot proceed until the failure is corrected; eighth, the track is double and stations are located on loops extending from one track to the other, but in a different plane—that is to say, the loop may preferably rise over the tracks or descend below them—the stations being located on said loops; ninth, in case a car passing from a loop to main track comes in danger of rear collision with a car on the main track the first-named car is automatically stopped; tenth, in case a car on main track comes in danger of rear collision with a car coming to main track from a loop the first-named car is automatically stopped; eleventh, a reversing gear is provided on each car, whereby from a distant point the motion of the car may be reversed; twelfth, an indicating mechanism is provided located at stations, whereby the speed of cars in proximity to the station is indicated and also their position at one side or the other of said station; thirteenth, a continuous sheet-steel hood may be provided when the tracks are above ground to protect the track, cars, and conductors and prevent derailment.

A LONG ELECTRIC ROAD.—Secretary of State Cook, of Missouri, has issued a charter to the Central Missouri Electric Railroad, with a capital of $4,000,000. The road is to extend from Brookfield to Glasgow and thence to St. Louis, a distance of 194 miles. Colonel W. H. Chase, of New York, is the principal financier of the road. The line is to be completed in time for the St. Louis Exposition.

INDEPENDENT TELEPHONY.—It is reported that there is a movement to consolidate the independent telephone companies in Vermont, Massachusetts, New Hampshire, etc., including part of New York State, and reaching out to Ohio and Indiana. The statement is made that toll line agreements have already been effected and that the People's Telephone Company, incorporated under the laws of Maine with a capital of $5,000,000, is organied to push the movement.

TROLLEY PROFIT SHARING.—The Street Railway Company, of Vancouver, B. C., has voluntarily decided that the regular employees shall receive as their share of its profits one-third of the amount available for dividends after the ordinary shareholders have received 4 per cent. This means, as estimated, that at the end of the first year each employee will receive about $30, at the end of the second year the share will be about $50, and in five years it will be $100. The men will receive the standard union wages. The plan is expected to do more than pay for itself.

A. I. E. E. PRESIDENCY.—Nomination forms have been issued for the Institute annual election, which is, as usual, exciting considerable interest. Mr. Scott's active year gives a much larger electorate to be polled. There are two distinctly leading presidential candidates. Mr. C. O. Mailloux, who has served the Institute with great credit in various capacities for years past and has been a generous giver to the Library, is being advocated vigorously by his numerous friends. The other candidate put forward is Mr. Bion J. Arnold, of Chicago, also well known in the profession and a large contributor to the Library funds. The West has never had a representative in the presidential chair, and Mr. Arnold's cause, aside from his rank as an able professional man, has been enthusiastically taken up out West, as well as by many in the East, on the ground of a better territorial distribution of offices and recognition in Institute work.

MESSENGER BOYS are not altogether angels, but it may be doubted whether they are as bad as the Child Labor Committee makes out. Unquestionably, there is a good deal of boy in them. According to the report of Miss Helen Marot, there are employed at one time, in the Boroughs of Manhattan and Brooklyn, by one telegraph company alone, about 1,000 youngsters. During the entire year some 6,000 lads are given employment by this company. In addition to this army of uniformed children there are hundreds of other boys employed by other somewhat similar companies, and of the whole number of urchins so employed it is probable that one-half started to work when they should still have been in school. One requirement of the telegraph companies is that the boys shall have reached the age of fourteen. To secure employment under that age boys declare themselves fourteen, when, as common observation indicates, and investigation proves, they are much less than that age. In one day twenty-six messenger boys assured an investigator that they were fifteen years of age, but it was learned from school records and other sources that twenty of them were only twelve or thirteen years old.

NEW YORK TRANSPORTATION is the subject of a report by the State Railroad Commissioners dealing with surface railway operation on Manhattan Island. The report is a virtual endorsement of the claim of the Metropolitan Street Railway that it has done everything possible under the circumstances, and the attitude of the city authorities in previous years is vigorously attacked. The Commissioners say: "Every attempt to lay a new track or make a new connection was denounced as "a grab"; the city has paid the full cost of the widening of Fifty-ninth Street, between Fifth Avenue and Eighth Avenue, as it will also do for the widening of Eighth Avenue, on Central Park West, and for the widening of Fifty-ninth Street east of Fifth Avenue, notwithstanding the street railway company was ready and offered to pay the whole expense. And it should be borne in mind that the company did not seek to lay down any new tracks in these widened thoroughfares, but only to help a freer car movement by giving greater room for all other vehicles. The board might multiply examples and give some very specific instances to show that there has been a petty, demagogic policy persistently pursued against all interurban railway enterprises in New York City, probably instigated by and dating, of course, from the Broadway Railroad scandal of 1884, and that the tendency has been to treat the corporations as the public enemy. To this very combination of circumstances is in some degree due the difficulties and the backwardness and the incapacity of the service to-day." It is recommended that the Interurban system add 250 closed cars as well as the 175 open cars now under contract.

STORAGE BATTERY CONTROL PATENTS.—Three patents issued February 10 to A. S. Hubbard cover systems of electric distribution in which the use and control of storage batteries are provided for. The first of these relates to a system in which two groups of batteries are used connected in parallel, one group being charged while the other is discharged into the external circuit. The battery which is under charge is connected directly to the generator, while a resistance is interposed between the generator and the load; a resistance being also inserted between the discharging battery and the load. A sliding switch is provided, which, when moved in one direction, increases the resistance between the generator and the load, while it decreases the resistance between the discharging battery and the load. A movement in the opposite direction gives a reverse effect. This allows an adjustment between the generator and the discharging battery, of the relative proportions of current to the external load supplied by each. A reversing switch throws the discharging battery directly on to the generator for recharging, while the charging battery is connected on to the discharge side. If the sliding switch be motor-driven and actuated to run backwards or forwards by voltmeter contacts as the voltage of the mains rises or falls, the adjustment is effected automatically. The second patent relates to modifications of the above. The third patent covers an automatic booster system in which the machine is of the separately excited class and is a modification of Mr. Hubbard's previous patent on boosters. The booster armature is in series with the battery and these connected across the mains. The booster field is in series with the armature of a small exciting dynamo and these are also connected across the mains. The exciting dynamo derives its field from the main current, which passes from the generator to the line, so that the voltage of this dynamo at any given speed is proportional to the main generator output. The voltage of this exciter dynamo opposes the impressed e.m.f. of the mains and its winding is such that when normal generator output is passing into the line—and through its field—its voltage is just equal to that of the line, and consequently no current flows through the booster field. The latter machine has under this condition zero voltage and the battery neither is charged nor discharges. The motor which drives the exciter has, in addition to the regular shunt field, a series field—which is also in series with the exciter dynamo field, and through which the current from the main generator passes. This series field opposes the shunt field, so that any increase in current from the main generator will cause a decrease in the field strength of the motor, with a corresponding increase in speed, and *vice versa*. Increase of generator current, therefore, causes the voltage of the exciter dynamo to increase, due to increase both of field strength and speed of driving motor, which voltage, exceeding that of the line, sends a current through the booster field, causing an e.m.f. to assist battery discharge. A reverse set of conditions causes the battery to charge when the generator current decreases.

LETTER TO THE EDITORS.

Line Poles.

To the Editors of Electrical World and Engineer:

SIRS: I should be glad to receive from your readers some information on the subject of hard pine poles suitable for electric light purposes. We have had occasion to use a large number of these poles, and we find that while some last as long as twelve years, others must be renewed in from five to six years. It seems to me

that the subject of the selection of suitable poles and treatment which would be practicable as well as efficient, is one that would be of interest to a large number of people in this country who are coming to believe that hard pine is a very inferior material for street poles.

W. F. STEVENS.

ALLSTON, MASS.

[A paper read by Mr. W. E. Moore at the Cincinnati meeting last year of the National Electric Light Association discusses the relative value for line poles of different woods, and gives an account of a method of treatment with creosote. An abstract of this paper appears in our issue of May 24, 1902. The subjects of the selection and treatment of line poles are considered in this week's installment of Mr. A. V. Abbott's series of articles on "The Construction of Aerial Telephone Lines."—EDS.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

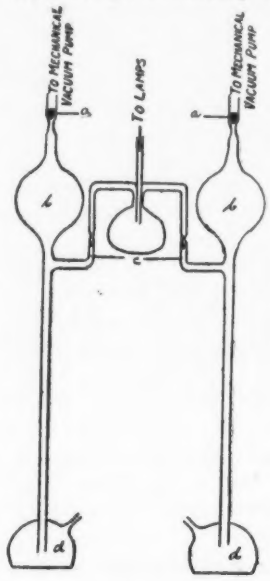
DYNAMOS, MOTORS AND TRANSFORMERS.

Design of Electrical Machinery.—ESSON AND E. K. SCOTT.—An illustrated abstract of two papers read before the (Brit.) Inst. Elec. Eng. Esson's paper deals mainly with Continental European practice. He shows that it is easier to design machines of large output to run at low speed than at high speed; at the same time, high-speed machines of large output have proved to be quite practicable. As the speed of a machine is increased, the hysteresis and eddy-current losses increase at a greater rate, while the temperature-coefficient may or may not decrease in the same ratio. If the armature is so designed that the curve of watts lost corresponds approximately to the temperaturec-coefficient curve, the heating of the armature may be practically constant over a wide range of speed. If this is not so, it may happen, as in a case cited by the author, that an increase of 50 per cent. of speed may admit of an increase in the output of only 25 to 35 per cent. The want of agreement in the values of the output coefficient of machines by different makers is due, to some degree, to variations in the methods adopted for ventilation, but more still to the divergency in practice as regards the proposition adopted for the prevention of sparking; different designers follow different principles concerning the last point; the former method was to provide sufficient forward induction to neutralize the self-induction of each armature coil during its period of short circuit, while at present the custom is to so proportion the armature that the e.m.f. generated in each coil during this period does not exceed the amount which has been found by experiment to give sparkless commutation with carbon brushes. The author's experience with laminated poles for direct-current machines, has not been altogether satisfactory. The advantages claimed for such poles are that it is possible to use wide armature slots and a smaller proportion of insulation in the active belt, thereby leaving more for a greater area of copper, and by cutting the alternate plates to a different slope it is possible to obtain a gradually fringed field, which lessens the armature hum and also lessens the tendency to spark. An important novelty in alternator construction is the tie-rod construction of the armature adopted by the General Electric Company, of Berlin; Dobrowolsky asserts that as compared with the usual design, this construction effects a saving of about 20 per cent. in weight of materials required in respect to a given output, and the saving in cost of construction is about 10 per cent. The object of this design is to do away with the heavy castings heretofore used to keep the armature true in its shape, and in their place to surround the armature with tie-rods having struts so disposed as to give the maximum resistance to distortion. Scott's paper deals chiefly with details of construction.—Lond. *Elec. Rev.*, January 23.

Heyland Motor.—HEYLAND.—A continuation of his long illustrated article, the first part of which was abstracted in the Digest last week. He first discusses the use of a direct-current winding with short-circuited commutator; its main disadvantage is the increase of the losses, due to the shunting by the connections between the segments. He then discusses the three-phase winding with a commutator, short-circuited in itself, and finally the three-phase winding with branches in parallel. The latter winding is the best one; it is always short-circuited through the brushes so that even without connections between the segments it has all the properties of a short-circuited winding. To accomplish this, each phase winding consists of two parts connected in parallel. The arrangement is explained by various diagrams.—*Elek. Zeit.*, January 29.

LIGHTS AND LIGHTING.

Pump for Incandescent Lamp Manufacture.—In an illustrated article on the Premier Lamp Works near Liverpool, the Reinmann mercury pump is described which is in use there. The design is based on the principle of the old lift pump; that is, the mercury alternating rises and falls in a glass vessel, which is connected at the top through a mercury sealed valve to a mechanical vacuum pump, and at the bottom through another valve to the lamps. The arrangement is seen in the adjoining diagram. When the mercury falls the top valve, *a*, seals so that a high vacuum is produced in the glass vessel, *b*. At the bottom of its stroke the mercury uncovers the connection, *c*, to the lamps, allowing the air in them to expand into the vessel, *b*. On its up-stroke the mercury closes the valve, *c*, and on rising drives the air before it through the top valve, *a*, into the pipe connected with the mechanical exhaust. The rise and fall of the mercury is obtained by connecting the bottom reservoir, *d*, alternately to the atmosphere and to a mechanical vacuum pump. One of the chief features of the arrangement is that each batch of lamps, usually a dozen, which are being pumped simultaneously, is connected to a pair of these pumps, the mercury rising in one and falling in the other. As the mercury rises more than it falls, the pumps are almost continuously in connection with one or other of the vacuum vessels, *b b*, into which the air from the lamps has time to expand while the up-stroke is being completed. Moisture is removed in the usual way by placing phosphoric anhydride between the lamps and the pumps. The whole of the pumps are worked from one point by an arrangement of stop-cocks. A movement of the controlling lever causes the mercury to rise on one side of the double pump and to fall on the other; on the completion of the stroke the lever reverses and so reverses the motion of the mercury. An extremely high degree of vacuum is said to be obtained with this pump.—Lond. *Elec. Times*, January 29.



MERCURY PUMP.

POWER.

Driving Boiler Feed Pumps.—JAMES.—A short article dealing with the various methods of driving boiler feed pumps. For an electrically-driven boiler feed pump, the author suggests that a triplex pump be used, the motor being run at constant speed. In order to cover the requirements for variations in the rate of pumping, the suction to the exhaust of one or two of the pump cylinders of the triplex pump is fitted with a by-pass valve of large capacity, so that to vary the rate of pumping it is only necessary to open the by-pass valve more or less. With the valves completely closed, the pump would work at its maximum output. If there are by-pass valves for two of the cylinders in the pump, the opening of two of the valves to the fullest extent would cut down the rate of pumping two-thirds. Such a pump would, of course, be more economical when driven from one of the large main engines. In point of fuel

consumption, the next best arrangement would probably be to drive the pump by means of an electric motor. If the pump were driven by a small independent steam engine, which could operate on 60 pounds of steam per indicated horse-power, as against 200 or 300 pounds for a direct-acting steam pump, there would still be considerable economy realized from a direct-acting steam pump.—*Am. Elec.*, February.

Refuse Destructor.—Broadbent.—An article in which he replies to some criticisms of De Legundo on the "fuel value" of town refuse. Whether or not it pays to burn refuse instead of coal is principally a matter of local conditions, in very many cases it certainly does. If refuse must be burned—and it should be for sanitary reasons—it is folly to waste the heat if it can be utilized in any way. It is absolutely wrong to contend that refuse has no "fuel" value.—Lond. *Elec. Rev.*, January 23.

REFERENCES.

Development of Mountain Water Powers.—Letheule.—A long and well illustrated article on water power developments in the French Alps, with reference to the recent "White Coal" congress.—*Eng. Mag.*, February.

Oil and Compound Feeders for Boilers.—Hobart.—An illustrated article describing the various makes of oil and compound feeders for boilers. The author also illustrates and describes various pieces of home-made apparatus.—*Am. Elec.*, February.

Traction.

Management of Tramways.—Wordingham.—An article on the commercial management of electric tramways. Great possibilities exist for tramways beyond the mere carrying of passengers. He discusses the traffic of express packages, etc. Concerning combined light and traction stations he makes the following remarks: The average cost of production in a combined station will be more than the cost in a station for traction only, and less than in one for lighting only, but the average cost in a combined station will be substantially less than the average of the cost in a traction station and in a lighting station serving the same loads, and there will be a considerable saving to both undertakings. In other words, the cost of producing the traction energy in a combined station will be substantially less than if it were produced in one solely devoted to traction, and the cost of producing energy for lighting will be less than in a station solely for lighting. The idea is wrong that a traction load provides a steady demand on the station for some 16 hours out of 24; a traction load is not much, if at all, better than a factory motor load, and is far inferior to that arising from street lighting.—Lond. *Elec. Rev.*, January 30.

Relation of Interurban Electric Railways to Steam Roads.—Wyly.—An article in which the rapid development of the interurban electric railway and the improved facilities which it offers are considered, as well as the influence which its development has had in increasing the public travel. It is contended that the electric interurban extensions have materially benefited the steam railways in spite of the fact that much of the suburban traffic of the old lines has been taken by the new electric system. It is pointed out that this is not an unmixed evil, as the steam trains are ill adapted to this class of service. This is now recognized by many steam railway managers who are encouraging the development of the electric lines as feeders to the steam trunk lines, and in some instances have substituted electricity as a motive power for suburban and branch roads.—*St. R'y Jour.*, January 31.

REFERENCE.

Pavement Plow Car in Chicago.—A description of this plow, which is drawn behind one or two motor cars, and will dig macadam pavement preparatory to track repairs. If necessary, the plow car can be loaded down with pig-iron. There are ten digging bars carried directly in the rear of the front wheels, and scrapers in the front of the rear wheels to scrape the débris from the rails.—*St. R'y Jour.*, January 24.

Installations, Systems and Appliances.

Rectifiers.—A long editorial on the Hewitt and Nodon rectifiers. As is well known, the former is an outgrowth of the Cooper-Hewitt vapor lamp, while the latter is an electrolytic cell with an aluminium electrode; the property common to both devices is that they allow the current to pass only in one direction. Concerning the Hewitt rectifier, reference is made to the statement that the apparatus will work up to 1,000 volts with a constant loss of only 14 volts, throughout its whole range "obviously then—if this statement is correct—the resistance undergoes some curious change, and the efficiency increases in direct proportion to the applied pressure." It is doubted whether the laboratory figure of 1,000 volts will be confirmed in actual practice. It is claimed that the difficulty of starting the converter, although not serious, cannot be overcome without making the apparatus complicated; and, as a consequence, it is more likely to break down. The resistance of the converter must first be broken down, before it will start, and this might be accomplished by means of a small step-up transformer. In single-phase working this transformer would have to be permanently connected to the terminals, or the resistance of the negative electrode would reassert itself and allow the rectifier to cease its functions. The presence of the transformer would entail a slight loss of energy, but a further and considerably greater disadvantage would be introduced by the continued increase of voltage, which might eventually result in the fracture of the bulb and admission of air. Having been taken up by the Westinghouse Company, the apparatus is in good hands, and we look forward to its emerging triumphantly from the exptrimental stage and becoming a practical adjunct to the plant of an alternating-current electricity works. Some notes are then given on the various theories of the electrolytic rectifier. It is said that if the apparatus can take the place of the motor-generator or synchronous converter, it has a great future, but in its present state the large space taken up is a great disadvantage. For instance, a 5-kw Nodon "electric valve" occupies over 12 cubic feet, and when working continuously must be kept cool artificially. The mere fact that it is liable to get overheated is a disadvantage, but with proper supervision there should be no difficulty in making it work quite smoothly and efficiently; there is also the question of cost. In the present state, both apparatus may be excellent devices for charging small batteries of accumulators, or even for working lifts and for the numerous minor operations which it is not possible or convenient to perform with alternating current, but improvements must be made before they can be successfully applied on a larger scale.—Lond. *Elec.*, January 23.

Pulsating Currents.—Holden.—An article giving "suggestions for the use of intermittent currents for electric lighting." By intermittent or pulsating currents he means that an alternating current is superposed on a direct current. He appears to advocate the simultaneous use of both pulsating current and direct current. "For instance, if continuous current were supplied during the day and pulsatory current during the night, it would be quite possible to arrange that certain lamps (say street lamps) were only lighted up when the current became pulsating; or that certain motors were only able to run during one or the other period." Another use to which the possibility of varying the character of the supply might be put would be in fixing the charge to be made for current supplied at different hours of the day.—Lond. *Elec. Rev.*, January 23.

Wires, Wiring and Conduits.

Wiring of Buildings.—Falconar.—A long abstract and discussion of a paper read before the Newcastle section of the (Brit.) Inst. Elec. Eng. He distinguishes exposed positions, ordinary positions, and unexpected positions. In discussing exposed positions, as in shipyards, in boiler shops, etc., he admits only the possibility of using gas barrel or welded steel tubing, although he puts in a plea for armored cable. As regards the first, he has experienced rough interiors, condensed moisture and deteriorated insulation, and there is waste of time in screwing and making special bends. In dealing with screwing, attention is drawn to the harmful effects of oil on the rubber, if it is not wiped off the threads, or if allowed to creep in from outside sources. Internal moisture is generally produced by condensation; this can be proved by observing the low insulation test obtained whenever there is a sudden fall of temperature. He advocates armored cables for exposed positions, and his tables of costs show that these are both cheaper to buy and to erect, than insulated cables and iron or steel pipes together. (Editorially it is here remarked that the cables should not be used for this purpose, unless they are first lead-sheathed and then armored.) He then discusses "ordinary positions" where there are such factors as general dampness, in moist plaster, etc. He appears to favor welded steel tubing, but makes it an important condition that the cables should be drawn in after the tubing has been fixed completely. Braze steel tubing is dismissed as unsatisfactory. He says that wood

casing may be used with success if it is water-proofed, but not otherwise. (Editorially it is here remarked that wood casing has done good service in the past, yet there is no reason for its use now, either on the score of economy, protection, or safety.) Concerning non-metallic tubing, he thinks it strange that this has not made much headway, and he suggests earthenware ducts let into walls of new buildings. (Editorially this is not recommended, as it would condense moisture equally with, or more than, metal tubes; moreover the sodium in the glazing might tend to become separated by the electrolytic action of any leakage currents.) Bitumenized fibre tubing has been found wanting in many qualifications. The author advocates running insulated cables on insulators, both for large buildings such as workshops, and for private houses. In discussing "unexpected positions" he deals with wood casing, split tubing (close joint), lead-covered wire and flexible. He does not seem to condemn wood casing, if used in dry places. (Editorially it is said that the possibility of becoming damp should be allowed for.) He dismisses split tubing as unsatisfactory. He recommends the lead-covered wire system (by which it is assumed he means paper-insulated). As regards flexible wires, he advocates some form of armority. The author's conclusion is that there should be fused armored cable for "exposed positions"; water-proofed casing and screwed welded tubing for surface and concealed work respectively, for "ordinary positions"; and cleat-insulators or lead-covered wire for "unexposed positions." The editorial critic, while reserving his opinion regarding the armored cable—unless it can be shown to be water-tight, when its use should prove of advantage—would drop wood casing altogether and only rely on the welded screwed tubing, the lead-covered wire, and the cleat system for use in all ordinary positions, according to the amount of money required to be spent.—Lond. *Elec. Rev.*, January 23. The paper itself is reprinted in Lond. *Elec. Eng.*, January 30.

Metallic Protection of Conductors.—PRENTICE.—An article in which he says that metallic tube systems, as usually installed, are utterly untrustworthy from the standpoint of safety. He admits that if properly installed, and if no future extensions are to be provided for—except from distribution boxes—are required, a screwed metallic barrel system is difficult to excel. But he says it is not often found "properly installed." He thinks that "to employ metallic tube as a protection is, under ordinary circumstances, to court disaster." An insulating tube of the nature of hard fibre rendered impervious to moisture and as nearly nail proof as possible, with joints on the same principle as ordinary unscrewed Simplex, seems to the writer to afford the most promising solution of the difficulty.—Lond. *Elec. Rev.*, January 27.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Effect of Electric Convection.—CREMIEU.—A paper on the present state of the question of electric convection, in which he endeavors to defend his position against the positive results obtained by Pender. The experimental problem, which was already surrounded by numerous difficulties, is said to be further complicated by a new cause of disturbance. He found that besides the theoretical effect of the convection of charges, an astatic magnetic system contained in a closed electric screen may, under certain conditions, be subject to a magnetic action which strongly deflects the needle and can even demagnetize it. This action may be produced by placing the astatic system in its screen above a horizontal metallic plate attached to a conductor of low resistance and no inductance, whose other terminal is put to earth. If now a condenser is discharged anywhere along the conductor, the needle receives a violent shock which displaces its zero. This effect can be stopped by introducing a high liquid resistance or a larger metallic screen. He points out that a disturbing magnetic effect may be produced by a loss of charge of the body conveying the electricity. He thinks that the final decision of the question will still involve much time and trouble.—*Jour. de Phys.*, December. Abstracted in Lond. *Elec.*, January 30.

Current Bridges.—SUNDORPH.—An account of experiments made in continuance of his work on the coherer and the Schaefer anti-coherer. When a current from two storage cells is passed between any two metals, and they are then slowly separated by means of a micrometer screw, a "bridge" about 0.01 mm thick and about 1 mm long is found between them. This bridge, which is seen under the microscope to consist of countless thin wires, accounts for the persistence of the current after contact has been apparently broken. No bridge is formed between platinum conductors. Between platinum and zinc a bridge is formed, especially if the platinum is cathode. Both aluminum and zinc are good bridging metals, but no bridge can be formed between one and the other.—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

Luminous Electric Wind.—WARBURG.—A paper on phenomena accompanying the discharge of an influence machine. The positive and negative poles are easily distinguished by the fact that long brushes proceed from the positive pole, while a minute star is attached to the negative pole. This star represents the negative glow light of the vacuum tube reduced to small dimensions by the pressure of the atmosphere. He shows that under certain conditions an electric wind can also proceed from the negative pole; this happens when the gas surrounding that pole is dry nitrogen at atmospheric pressure. If the pole is charged to a negative potential of some 2,500 volts, not only the star is seen, but a fine pencil of light, which at first sight resembles the positive brush discharge remarkably closely; as a matter of fact, it is luminous negative electric wind.—*Ann. d. Phys.*, No. 1; abstracted in Lond. *Elec.*, January 23.

Velocity of Röntgen Rays.—BLONDLOT.—An account of an investigation the results of which confirm the prevailing theory that Röntgen rays are but an irregular series of single-wave pulses, making up what might be called, by an acoustic analogy, an optical "noise." He tested whether the different varieties of X-rays, which we know to have very different powers of penetration, differ in their velocities, as do the rays given out by the different radio-active bodies. He found that whatever kind of vacuum tube from which X-rays might be obtained, their velocities were always equal to the velocity of light in air. The experiments were made by the method already described. Indeed the previous experiments made it probable that the rays had a fixed velocity, as otherwise the maximum could not well have been a decided one, however the tube might be working. The author also found the natural conclusion verified that the velocity is independent of the medium through which the rays are propagated, since there is no refraction. He verified this for wood, paraffin, vaseline, oil and essence of turpentine.—*Comptes Rendus*, December 29; abstracted in Lond. *Elec.*, January 30.

Capillarity of Solutions.—A short note on an investigation by Mathieu. When a dried pig's bladder is placed in a salt solution, the concentration of the solution absorbed is less than that of the original. The introduction of suitable electrodes allows the system to be regarded as a concentration cell, and the e.m.f. of this cell is a measure of the difference between the concentration of the solution and that of the portion absorbed by the bladder. Qualitatively, porous cells and tiles, parchment paper and capillary tubes exhibit the same phenomenon. In the last case it is found that the smaller the radius of the tube the greater is the difference of concentration produced; hence it is not permissible to determine the surface tension of electrolytic solutions by measuring the heights to which they will rise in a capillary tube.—Lond. *Elec. Eng.*, January 9.

ELECTRO-CHEMISTRY AND BATTERIES.

Disassociation of Electrolytes.—LIEBENOW.—A theoretical article in which the author discusses the reasons why Ostwald's well-known formula for the electrolytic conductivity as a function of the concentration, does not agree with the facts in the case of the highly ionized solutions of ordinary inorganic salts and acids. He develops a new formula which is more general than Ostwald's, as it contains two empirical constants, while Ostwald's contains only one. In the case of potassium chloride the formula is shown to be a good representation of the change of conductivity over a wide range of concentration.—*Zeit. f. Elektrochemie*, December 25.

REFERENCES.

Edison Battery.—HIBBERT.—An article with the title "Edison contra Jungner," and quoting some statements from a Stockholm paper. Some notes are given on runs made by automobiles provided with Jungner alkaline cells in 1900 and 1901; and it is claimed that Jungner's invention was prior to Edison's.—Lond. *Elec. Rev.*, January 30.

Phase Rule.—VAN'T HOFF.—A long abstract, illustrated by diagrams, of a lecture on Gibbs' phase rule, its application to different cases, and on graphical methods for representing such chemical problems.—*Zeit. f. Elektrochemie*, December 25.

Units, Measurements and Instruments.

Measuring High Temperatures.—Fery.—A description of a new method for measuring high temperatures, based upon the law of Stephen, the conditions of which are fulfilled for bodies enclosed from all sides, which is the case in the electric furnace. In the author's apparatus the radiation is concentrated by means of a lens upon a thermocell and its e.m.f. is measured. A comparison of this apparatus with the pyrometer of Le Chatelier gave differences of less than 1 per cent. between 1,000 and 1,500° C., while below 900° the differences were greater on account of the small deflections. The author in this way found the temperature of the positive carbon of an electric arc lamp to be 3,490°. For very high temperatures, this method appears to be very suitable.—*Comptes Rendus,* v. 134, p. 977; abstracted in *Zeit. f. Elektrochemie,* November 20.

Capillary Electrometer.—Boley.—The electrometer in which only a drop of mercury is used is very advantageous for null methods, but maxima cannot be observed by its means, and the drop is liable to slip out of the tube. Boley describes two new types which lend themselves to all kind of measurements. Since the sensitiveness depends upon the mobility of the meniscus and the power of the microscope, each of these two factors should be made a maximum. The mobility of the meniscus would be infinitely great for a form of the electrometer in which the mercury would be in a state of indifferent equilibrium. Such a state could be realized by putting the capillary tube into the shape of a hyperboloid of revolution; but most capillary tubes approximate to this shape more or less, and have a region of indifferent equilibrium slightly below their thinnest bore. By choosing a tube of nearly hyperboloidal shape, the author is enabled to measure an e.m.f. of 0.00001 volt with an enlargement of 840 and a water manometer. The bore is 0.25 mm and the mercury thread is only 2.75 cm long. Another form of tube resembles Lippmann's reversed pattern, and has a bore as large as 1 mm. It measures 0.0001 volt.—*Jour. de Phys.,* December; abstracted in Lond. *Elec.,* January 30.

REFERENCE.

Measurement of E.M.F's by Means of the Telephone as Zero Instrument.—Fischer.—A description of a method of using the telephone as a zero instrument for the measurement of e.m.f's and currents. It has been used for a long time in Kohlrausch's method of measuring the conductivity of electrolytes. The present one is based upon Poggendorf's compensation method, or the potentiometer method, and differs from it only in that a telephone is used in place of the usual galvanoscope, and that there is a make and break in the telephone circuit, operated from an independent source of current; there are also two high resistances in the telephone circuit, the lesser one of which is used only for the finer adjustments. A diagram of the connections is given and a measurement is described.—*Zeit. f. Elektrochemie,* January 1.

Telegraphy, Telephony and Signals.

REFERENCES.

Telephone Engineering.—Dommerque.—A short article in which the author deals with the preservation of timber by processes other than the one of creosoting.—*Am. Elec.,* February.

Independent Telephone.—Clausen and Hubbell.—Two articles on the progress of independent telephony.—*Tel. Mag.,* January.

Toll Lines.—Wegner.—An article in which he gives a series of diagrams showing the connections for toll lines and interurban circuits.—*Tel. Mag.,* January.

Miscellaneous.

Visibility of Ultra-Microscopic Particles.—Siedentopff and Zsigmondy.—A description of a method of making small particles visible. which considerably extends the range of microscopic vision, and brings us within a short distance of molecular dimensions. The method is a form of "dark field illumination" with sunlight filtered through a narrow slit. The particles specially examined are gold particles in ruby glass; these are exceedingly small, and although they cannot be seen as they actually are, they appear as diffraction discs about 1 mm in apparent diameter; this means an enlargement of 50,000. The objection that the disc does not show the real object, also applies to the fixed stars, which appear in the most powerful telescope only as diffraction discs. The limit of the method is about 10 times the diameter of a molecule, and the authors prove that some of the gold particles are smaller than that limit. By counting the number of particles in a certain volume and estimating the total amount of gold present, they arrive at the size and weight of the particles. Molecules themselves could be seen only if the microscope could be made much more sensitive.—*Ann. d. Physik,* No. 1; abstracted Lond. *Elec.,* January 30.

The method is discussed in an editorial note. It is said to be simply an extension of well-known microscopic principles. What hitherto blocked the way was diffraction, which becomes very troublesome as the diameter of the particles to be observed decreases. Now this difficulty has been overcome by rigidly excluding the illuminating beam from the field of vision; hence the numerous reflecting and refracting surfaces employed in its transmission are no longer able to disturb the pure diffraction cone by which an ultra-microscopic object makes its presence evident. Therefore something is seen in the microscope, provided the objects are not so closely crowded that their diffraction cones overlap; what is seen is of course only a diffraction disc.—Lond. *Elec.,* January 30.

Magnetic Separators.—Danneel.—In this continuation of his long illustrated serial on the Dusseldorf exhibition, he discusses a number of metallurgical apparatus; most of them are purely mechanical, but among them are some magnetic separators, including a diagram of the well-known Wetherill separator. The Heberle separator employs a wet process; the particles of ore fall through a rising stream of water while exposed to the action of a magnetic field; the chief advantage of this construction is said to be that the adhesion between the single particles of ore is so completely removed that those which are magnetic are absolutely free from the non-magnetic ones.—*Zeit. f. Elektrochemie,* January 8.

Röntgen Rays in Practice.—Lowe.—A note on a paper read before the Röntgen Society in London in which he gives an account of his experiences of the use of X-rays in the treatment of cancerous growths, lupus rodent and other ulcers. In cases of new growths he found exposure to X-rays to be of very great benefit, and many diseases formerly supposed to be incurable now yield to this treatment. In one case of a malignant growth on the breast, he had given an exposure of 25 minutes; here an operation had been advised, but this was rendered unnecessary by the therapeutic action of the rays. Turning to radiography, he described cases in which this had been of the greatest service in his practice. It is of the highest importance in radiography to have the anode adjusted immediately above the line of fracture in order to secure good results. The reason for the slow advance seemed to lie in the want of definite lines of treatment and of suitable apparatus, which should be readily available.—Lond. *Elec. Eng.,* January 9.

New Books.

Leitfaden zur Konstruktion von Dynamomaschinen. Und zur Berechnung von Elektrischen Leitungen. Von Dr. Max Corsepius. Berlin: Julius Springer. 269 pages, 108 illustrations. Price, 5 marks.

This is a compact little work intended as an exposition of the principles of practical dynamo construction. In many respects it somewhat resembles the English text-book of Wiener on dynamo machinery, but is very much less pretentious, much more condensed and destitute of the extensive tabular information given by Wiener. The first 50 pages are occupied with the discussion of the magnetic qualities of the various irons employed in dynamo machinery. The principles of frame design succeed and then a few pages upon the various kinds of windings. The remainder of the work is chiefly devoted to working out in detail a number of designs for dynamo machinery, and in this respect the book is of value, giving practical illustrations of the method of calculations.

Der Elektrische Betrieb von Fernschnellbahnen. By Gustav W. Meyer. Halle a. S.: Wilhelm Knapp. 63 pages.

This little book investigates the general problem of high-speed electric railroad traction. The application of the three-phase, high-tension system is analyzed in the simplest manner and with various assumptions of engineering data. A comparison is made of the system of alternating-current motors supplied by step-down transformers carried with the cars, and the system in which the transformers are stationary and supply secondary conductors along the track. A particular case is outlined on both plans, and the first-

named is indicated to be preferable. This is the method which has already been initiated in Germany and Switzerland. The pamphlet is directed to technical students of electric railroad engineering.

ELECTRICAL ENGINEER'S POCKET BOOK. A Handbook of Useful Data for Electricians and Electrical Engineers. By Horatio A. Foster. New York: D. Van Nostrand Company. 987 pages, illustrated. Price, $5.00.

The crying need which this useful book supplied is indicated by the fact that it has in a short period entered a third edition and more than 5,000 copies have been sold. A number of corrections were made on the plates previous to the printing of this edition.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE, Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York. Next meeting, February 18, American Institute. Illustrated Lecture by Dr. A. E. Kennelly, "Submarine Cables."

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION, Secretary, E. W. Pichardt, Huntingburg, Ind.

Power Required to Drive Machine Tools in a Locomotive Shop.

We record here some power tests made recently in the locomotive shops of the Buffalo, Rochester & Pittsburg Railway, at Du Bois, Pa. The plant consists of five buildings, viz.: the power house, a building containing the locomotive erecting, boiler and machine shops, the round house, the blacksmith house, and the storehouse and offices. These buildings are located on a plot of ground 32 acres in extent and the equipment is intended to handle the repairs of about 150 locomotives, with provision for an increase of 75 engines, which is expected to cover about five years, making an estimated ultimate total of 17 engines per month. The machine, boiler and tank shops are under one roof, covering an area of 134 x 524 ft. The blacksmith shop is 80 x 140 ft., the power house 63 x 93 ft., the office and storehouse 60 x 120 ft., and in addition to these there is an oil house 30 x 60 ft., a 16-stall round house, and a 26 x 140-ft. coal, coke and iron storage building.

The power plant is located in a separate building and is designed for the transmission of power by electricity and compressed air, and furnishes all power needed for driving the machinery, lighting the shops, grounds, a large car-building plant and neighboring stations, and the further supply of steam for heating the buildings. All pipes and wires pass from the power house to the several buildings through underground galleries. The boiler equipment comprises four 200-hp water tube boilers, the furnaces of which are hand-fired. The engine room contains the following Westinghouse machinery: A 200-hp compound engine, direct-connected to a 125-kw, direct-current, main compound-wound generator, operating at 250 volts, and 280 r.p.m. This main generator carries the day load and supplies power for machine tools, cranes, lighting, etc. A 100-hp, simple engine, belt-connected to a 75-kw, direct-current, compound-wound generator, operating at 250 volts and 750 r.p.m. This generator carries the night load and supplies power for lighting, motor driving for special night work and the turntable. The night and day load generators are interchangeable at the switchboard.

There is a Westinghouse 100-hp, simple engine, belt connected to a 60-kw, 2-phase, alternating-current generator, operating at 2,200 volts, 7,200 alternations and 900 r.p.m. This generator furnishes power for lighting the yards, the Falls Creek Station, the passenger and freight stations at Du Bois and the Du Bois car shops. A 2½-hp exciter, operating at 125 volts and 180 r.p.m. An Ingersoll-Sergeant, steam-driven compressor, furnishing compressed air for the plant.

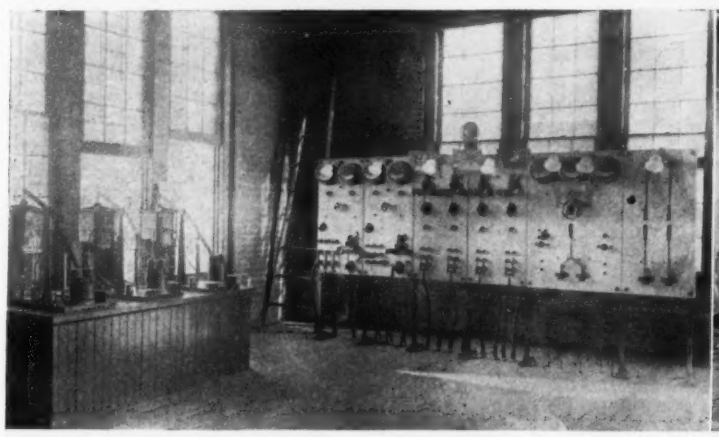


FIG. 1.—SWITCHBOARD.

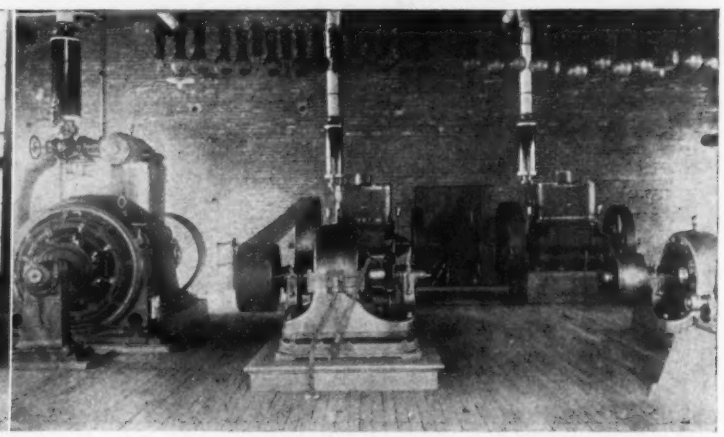


FIG. 2.—INTERIOR OF POWER HOUSE.

The tests made, in addition to furnishing accurate data relating to the power required for various tools when starting, running light and cutting, also make possible some estimation of the merits of roller bearings for shaft hangers. The line shafts are cold-rolled steel and are carried on roller bearings and a shaft 200 ft. long without belts could be turned by hand. But in spite of the unusual efficiency of the bearings, it was noted that the power consumed by the tool is often less than that lost in transmission. Nevertheless, the capacity in motors required for the group drive is two to two and a half times smaller than it would have been had each tool been provided with an individual motor. It is a question as to how

far the low average power taken by large groups of tools in operation may be due to the fly-wheel action of the shafts and pulleys.

The locomotive-erecting, boiler and machine shop consists of a middle aisle for erecting and two shed bays equipped with shafting for driving the machine tools. Two 50-ton electric traveling cranes have a runway in the middle aisle. There are five lines of shafting driven by five shunt motors in the shed bays and the sections are designated as wheel section and boiler section in one bay, and lathe, tool and flue sections in the opposite bays.

Wheel Section.—Shafting driven by a 40-hp, shunt-wound motor and operating 42-in. car wheel boring mill, 48-in. car wheel lathe, 2 79-in. wheel lathes, quartering machine, 60-in. x 60-in. x 18-in. planer, 84-in. boring mill, single axle lathe, 6-ft. radial drill, 18-in. slotter, band saw, No. 7 grinder, water tool grinder. The line shaft is 200 ft. long, 2½ in. in diameter, and has 26 hangers. It was inconvenient in this instance to obtain a test of the line shaft alone. A test of the line shaft and counters only gave 1.5 hp. A 15-minute test was made of a group of machines comprising a 72-in. and a 66-in. wheel lathe each with two cuts, a wheel press operated at 50 tons, and an 84-in. Niles boring mill, a band saw belt, an emery wheel, a Pond radial drill and a 60-in. planer with one tool cutting cast iron, with an average result of 4.6 hp, a minimum of .88 hp and a maximum of 10.43 hp. The speed of the line shaft was 160 r.p.m.

Two machines were then thrown in, a 42-in.wheel lathe cutting with one tool and an 84-in. boring mill—with the wheel lathe cutting, the boring mill on starting up took 6.9 hp, and cutting 3 hp. To the above two machines were added, a tool grinder and a 79-in. wheel lathe cutting, which starting up took 6.3 hp, and running steadily 3.95 hp. To the above was added a 60-in. planer, cutting a cast-iron cylinder, which at starting took 10.3 hp, and running steadily 4.2 to 7 hp, or an average of 6.1 hp during the whole time. To the above were added another tool grinder and an 18-in. slotter. The maximum reversals of the planer and the slotter at the same instant gave 15.5 hp, and steady running showed 5.2 hp. The planer interfered somewhat with the readings. To the above was added a band saw cutting 4-in. oak, which took 5.6 hp. Whether the saw was cutting or not seemed to make no difference in the reading.

Tests of single machines were then made; that is, of the power consumed by the one machine tool thrown in at a time. A 42-in. wheel lathe with one tool cutting took on starting up 4.6 hp, and on steady running .5 hp. An emery wheel took .7 hp. A 79-in. wheel lathe with two tools making roughing cuts on a pair of drivers took 4 hp. An 84-in. boring mill boring an 8-in. cylinder took 2 hp. A 60-in. planer cutting a cast-iron cylinder took 2 hp, and a maximum at reversal of 8.5 hp. An 18-in. slotter with tools of ¾-in. face cutting steel took .3 hp, and a maximum at reversal of 1.2 hp. A band saw starting up took 6.3 hp and running light or cutting 4-in. oak 4 hp.

A group run of an 84-in. boring mill, a 79-in. wheel lathe, a 6-ft. radial drill, a 60-in. planer and an 18-in. slotter gave at steady running 6.9 hp, and with the planer at reversal took 14 hp.

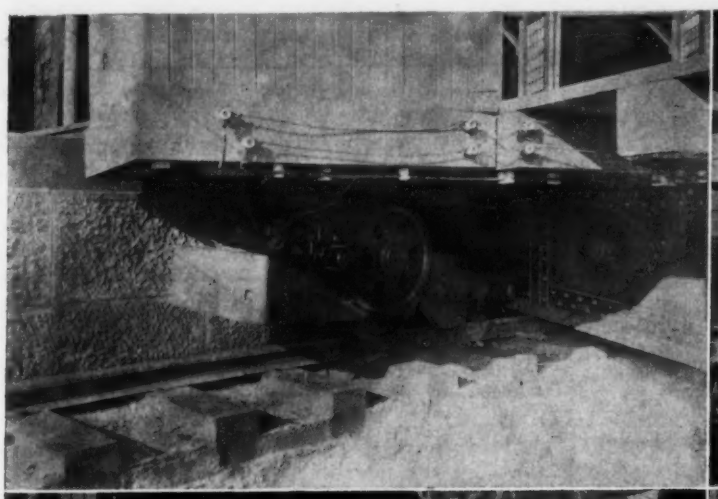


FIG. 3.—TURNTABLE DONKEY.

FIG. 5.—BOILER SECTION OF SHOP.

FIG. 4.—FLUE SECTION OF MACHINE SHOP.

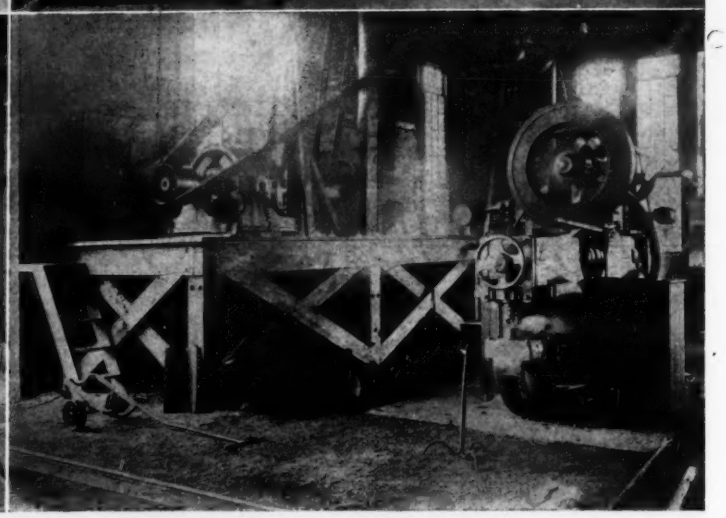


FIG. 6.—BLACKSMITH SHOP.

ELECTRIC POWER FOR MACHINE TOOLS IN LOCOMOTIVE SHOP.

Boiler Section.—Shafting driven by a 30-hp, shunt-wound motor and operating 12-ft. bending rolls, bolt cutter, stay bolt cutter, drill press, tool grinder, Brooks plate planer, horizontal punch, shear and punch, 6-ft. bending rolls, 6-ft. straightening rolls, 6-ft. radial drill. All the counter belts were thrown off and the line shaft tested alone, with a result of .3 hp. This line shaft is 170 ft. long, 2½ in. in diameter and has 19 hangers. The speed of the line shaft was 158 r.p.m. A test of the line shaft and counter shafts only gave an average of 2 hp. The machines comprising the first group tested were a stay-bolt cutter and a bolt cutter, a No. 4 Hilles & Jones punch and shear. The No. 4 punch and shear was punching 13/32-in. holes in 3/16-in. steel plate. A 15-minute test showed an average of 1 hp, with a minimum of .2 hp and a maximum of 3.5 hp.

A single tool, the No. 4 Hilles & Jones 48-in. punch and shear was then thrown in, and starting up light took 6.9 hp, settling down to .4 hp. Shearing 5/16-in. steel plate, it required 3 hp.

A 6-ft. radial drill was then added, and at starting up light took

3.6 hp, settling down to 1.1 hp. A 1½-in. drill cutting in steel gave 1.5 hp. A 6-ft. radial drill and bolt cutter required 1.1 hp. The 12-ft. rolls were then added, and starting up light showed 7.3 hp, settling down to 4.75 hp. Rolling steel plates, ½-in. x 8-in. required 5.3 hp. A test of line shaft and counters with the 6-ft. radial drill cutting steel with 1½-in. drill, and a punch and shear running light showed 2 hp. A 1-in. stay bolt cutter added to the above took on starting up 4.5 hp, and cutting 12 threads per inch gave 2.1 hp.

Lathe Section.—Shafting driven by a 30-hp, shunt-wound motor and operating 24-in. crank planer, 36-in. x 36-in. x 20 ft. planer, 51-in. boring mill, 16-in. shaping machine, 24-in. lathe, 24-in. drill press, 37-in. boring mill, two 22-in. lathes, three 16-in. lathes, two 18-in. lathes, 28-in. lathe, 43-in. lathe, 2-in. x 24-in. flat turret lathe, two 26-in. x 26-in. x 10-ft. planers, 60-in. horizontal boring machine, water tool grinder, centering machine. The line shaft and counters gave 4.1 hp. A test of the line shaft with counterbelts off gave .7 hp. The speed of the line shaft was 155 r.p.m. The line shaft is 180 ft. long, 2½ in. in diameter and has 22 hangers. A 15-minute test was made of a group of machines comprising two 26-in. planers and one 36-in. planer, cutting steel with one tool each, a turret lathe, an emery wheel, three 16-in. lathes, two 22-in. lathes, a 36-in. boring mill, drill press and a shaper, all in operation. The readings gave an average result of 6.9 hp, a minimum of 4.74 hp and a maximum of 15 hp. A group run of a 26-in. planer, three 16-in. lathes, an 18-in. lathe, a 24-in. lathe, a 16-in. shaper, a 24-in. drill press and a centering machine in operation required at steady running 2.4 hp, and at reversal of the planer 7.6 hp.

A single 26-in. planer cutting cast iron took 1 hp, and at reversal 3.5 hp. A 16-in. shaper cutting 1/32-in. steel at 12-in. stroke took .9 hp, with a minimum of .2 hp and a maximum of 1.4 hp. A 24-in. turret lathe cutting required .3 hp. A 24-in. lathe boring brass took .03 hp.

Tool Section.—Shafting driven by a 20-hp, shunt-wound motor and operating tool grinder, drill grinder, 21-in. drill press, 16-in. lathe, milling machine, grinding machine, three 18-in. turret lathes, 24-in. drill press, 28-in. lathe, No. 10 vertical milling machine, 2-spindle rod drills, 14-in. pillar shaper, 16-in. lathe, 26-in. x 26-in. x 6-ft. planer, 32-in. drill press, surface grinding machine, water tool grinder. The line shaft and counters required 2.8 hp. The line shaft is 140 ft. long, 2½ in. in diameter, and has 20 hangers. It was not convenient to obtain a test of the line shaft alone. The speed of the line shaft was 155 r.p.m. The line shafts of the lathe and tool sections can be connected by a clutch coupling and the whole operated from either motor. A group test was made of a 16-in. lathe, a drill press and a grinder, all in operation, with a result of 1.9 hp.

A single grinder took in starting up 9.7 hp, and grinding 1.95 hp. A 28-in. lathe took on starting 4.7 hp and cutting steel 2.5 hp. A group run of two 16-in. lathes, a shaper and two grinders in operation showed 2.5 hp.

Flue Section.—Shafting driven by 10-hp, shunt-wound motor and operating flue welder, flue cleaner, two No. 7 Jarecki pipe-threading machines, two pipe cutters. A test of the line shaft with all counters gave .6 hp. A test of the line shaft gave .035 hp. The line shaft is 90 feet long, 2½ in. in diameter, and has 12 hangers.

A single flue welder with blowing fan attached required on starting up 7.1 hp. Running light it took 3.4 hp. The pipe cutter cutting 2½-in. pipe took .06 hp. The auto-flue cleaner, cleaning 2-in. flue, took .2 hp.

Flue Rattler.—Outside at the end of the machine shop is a flue rattler operated by a 7½-hp, shunt-wound motor.

Blacksmith Shop.—The blacksmith shop is driven by a 40-hp, shunt-wound motor, which is belted to 75 ft. of 2½-in. line shafting with 12 hangers. The apparatus driven comprises a bolt header, a 25-in. punch and shear, a cutting-off saw, a tool grinder, a 40-in. planer, a drill press, a 50-lb. hammer, a blower, and an exhaust fan. A test of the line shaft and counters with grindstone and two blowers constantly in operation gave 14.5 hp. The bolt header added to the above gave on starting 7.8 hp, running light .5 hp, and heading 1-in. bolts 3.5 hp. A No. 2 Hilles & Jones punch and shear added to the above, first condition, gave on starting up 5.5 hp, running light .5 hp, and shearing 1½-in. round bar 4.3 hp.

Turntable.—The turntable is 70 ft. long and is operated by a 10-hp, direct-current motor of the street railway type geared to an independent traction wheel, the driving combination being supported in a pivoted frame, or "donkey," which rests with all its weight upon the turntable track, even when the table is tipped by a locomotive. The power is led to the motor through a sliding contact placed on the bridge above the center of the turntable. With the table running light and the controller on full, a test gave 4.45 hp. In throwing on the controller and accelerating up to full speed 5 hp was attained, which dropped to a constant of 4.45 hp.

With a locomotive on the table, weighing with tender approximately 286,000 lbs., a test gave 7.35 hp when accelerating to full speed. When full speed was attained, the test showed 5.43 hp.

Power House.—Switchboard readings of the ammeter and voltmeter were taken every five minutes, from 1:00 P. M. to 5:30 P. M., with averages of 220 volts and 250.7 amperes, or 73.8 hp. The minimum current was 200 amp, or 59 hp, and maximum current 300 amp, or 88.5 hp, the average of which is 250 amp, or 73.75 hp.

These tests were carried out by Messrs. H. M. Palmer and George H. Gibson, of the Westinghouse Electric & Manufacturing Company, and were made possible by the courtesy and permission of Mr. F. T. Hyndman, master mechanic, and the kind assistance of Mr. C. D. McArthur, chief draftsman of the Buffalo, Rochester & Pittsburg Railway Company.

Direct Driven Machine Tools.

The accompanying illustrations show several machine tools equipped with Storey motors. Fig. 1 represents a shaper fitted with a motor, and the arrangement is such that the speed of cutting may be readily adjusted to suit the conditions of service, to do which requires a speed variation of about 3 to 1, with a low speed of about 500 r.p.m., and from 1 to 3 hp, depending upon the work to be done.

Fig. 2 represents a blower that is compact, dust-proof and so constructed that the speed can be adjusted in 50 increments, from 400 to 2,400 r.p.m., with a very satisfactory economy if it is considered that the speed changes do not involve an armature resistance. The makers state that motor is dust and moisture-proof, runs well within "Navy" specifications, and is sparkless in point of commutation at all load changes.

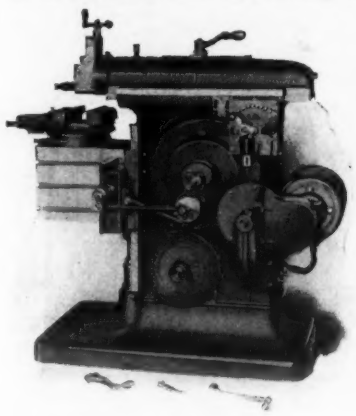


FIG. 1.—SHAPER.

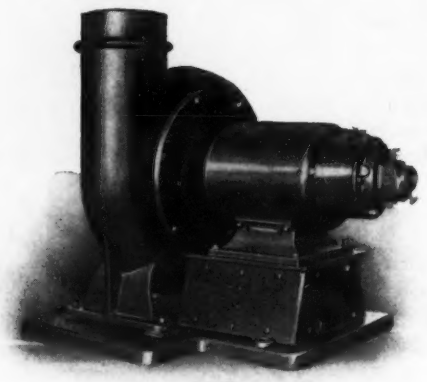


FIG. 2.—BLOWER.

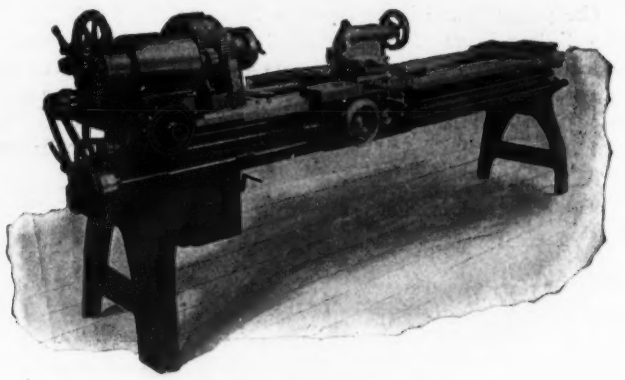


FIG. 3.—"REED" LATHE.

Fig. 3 represents a "Reed" lathe, arranged with a variable-speed Storey motor, which forms an integral part of the lathe, with every facility for giving all the speed changes that can be desired in any service.

Fig. 4 represents a Prentice lathe with still another style of at-

tachment of the motor, no less compact. The power required depends, not upon the "swing" of the lathe in any given case, but rather upon the kind of material being removed, and the amount of that material removed in a given time. It is a fact, nevertheless, that large swing, heavy lathes, are used as a rule for heavy cuts at

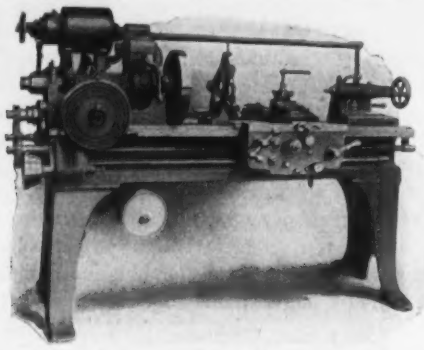


FIG. 4.—PRENTICE LATHE.

high speeds and rapid feeds, hence it is desirable to employ motors in proportion.

Not considering special service, it is generally safe to allow motors for lathes about as follows:

Swing of Lathes	12"	16"	20"	24"	28"	32"	36"
H.P. rating of motor	1	1½	2½	3¾	5	7½	10
Speed changes in per cent.	500	450	400	350	300	250	200
Lowest speed, r.p.m.....	550	500	475	450	400	350	300

Speed changes—From 20 to 60, depending upon service.

The above data are no more absolute than is the fact that the material to be cut is fixed; to illustrate this point it may be said that a 36-in. lathe turning gun barrels with ¾-in. x ¼-in. "blue" turnings, will require the large size motor, whereas the same lathe on brass castings might be all right using a motor of one-half that size.

Electric Power Equipment for a Japanese Arsenal.

One of the most complete and up-to-date electric power plants recently installed in Japan is located at the Osaka Military Arsenal. This installation was made for the purpose of operating the electric cranes; and blowers for the cupolas in the new foundry just completed. The foundry is built of red brick, with a corrugated iron roof, the inside dimensions being 86 m 300 x 33 m 400. It is equipped with four 10-ton, one 25-ton and one 20-ton Morgan cranes; also four 4-ton and six 7-ton cupolas, two being made by the Whiting Foundry Equipment Company and the others in the Arsenal itself. Four Root blowers, each driven by a Westinghouse 40-hp induction motor, supply the blast for these cupolas.

The power house is equipped as follows: In the boiler room are two Sulzer-Frere Cornish shell boilers, center-fired, each having heating surface of 62 square meters and a grate surface of 1.8 square meters. Each boiler is complete with its own heater, consisting of two plain cylinders each of 600 mm diameter and of the same length as the boilers. These heaters are mounted over the boiler shells and suspended from the angle irons supporting the brick work. One Worthington duplex pump and one restarting injector are provided for supplying feed water to the boilers.

In the engine room there are two Sulzer-Frere vertical, tandem-compound, single, balanced-crank engines with high-pressure cylinders 325 mm in diameter, low-pressure cylinders 475 mm in diameter and stroke 300 mm, operating under a steam pressure of 8 atmospheres at 257 r.p.m. The low-pressure cylinders have a fixed cut-off and the high-pressure cylinders a variable cut-off. Each engine is provided with a heavy fly-wheel by means of which the angular variation of the engine speed is reduced to a minimum. The condensers are a part of each engine, operating from the crank-shaft by eccentrics.

Direct coupled to each engine is a Westinghouse 100-kw, 220-volt, 3-phase, 3,600 alternations, composite-wound generator of the two-bearing, revolving-armature type and standard construction. The armatures are of the slotted drum type, the cores being built up of laminated sheets of steel, pressed on the cast-iron spider and held in place between two end plates. The armature windings consist of strap-wound coils formed and insulated before being placed in the slots, the coils being held in the slots by retaining wedges of hard fibre, thus requiring no bands. Two 11¼-kw, 125-volt, multipolar exciters, driven by belt from the main engines, furnish field current for the separate field of the generators, each exciter having sufficient capacity for two generators. The switchboard, to which the two generators are connected in parallel, is of the Westinghouse standard type "8" construction. There are two 3-phase feeders, of 0000 B. & S. gauge, each leading out from the power house to a distribution panel located at a convenient point in the foundry, from which the circuits of the various cranes and blowers are supplied. Before any load was put on the generators they were synchronized and it was noted from the ammeters and tachometers that there was no perceptible angular variation in the engine speeds and no cross currents flowing between the armatures. As it was not possible to get a steady motor load, the generators were given a trial run on a non-inductive load. This load was obtained by rigging up three water barrels with iron plate terminals, three plates being fastened at the bottom of the barrels and the other three lowered into the water by pulleys overhead. The artificial load thus secured provided an excellent means for properly adjusting the compensating field for perfect parallel operation and for taking care of the full range of the machines. After this test a full load run of two hours was made with the cranes and blowers working.

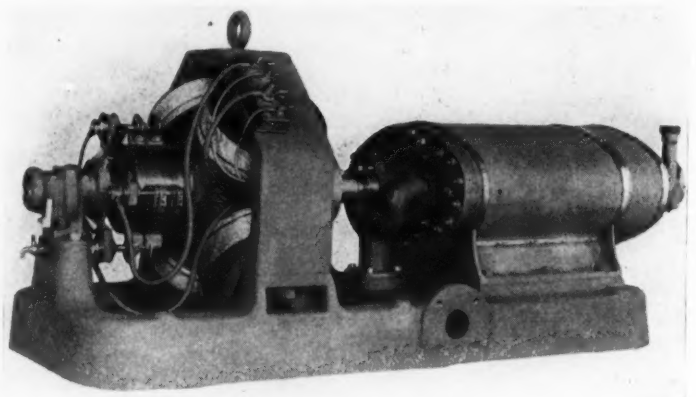
The cranes are all equipped with Westinghouse standard variable-speed induction motors and Westinghouse crane controllers. The very close regulation of the motors and the perfect control of the cranes were subjects of much comment by the directors of the Arsenal.

The design of the power house and foundry, together with the lay-out of all machines in the latter, came directly under the supervision of Mr. G. Kuwada, the mechanical engineer of the Arsenal. The foundry is a model of completeness in every detail and reflects great credit upon Mr. Kuwada, who is one of the most clever engineers in Japan. All of the electrical apparatus, as well as the cranes, blowers and two cupolas were supplied by Messrs. Takata & Co., who are the sole agents in Japan for Westinghouse electric apparatus.

Small Generating Set.

The accompanying illustration shows a small generating set which was installed in the power plant of the Keystone Telephone Company, of Philadelphia, some four months ago, and has been in continuous operation there ever since, contributing its share to lighting the building. The novel feature of this set is not the generator, but the engine, which is one of nine of its type built and installed by the inventor, Mr. E. C. Warren.

As is apparent from the illustration, the Warren engine is of



GENERATING SET DRIVEN BY ROTARY ENGINE.

the rotary type, but beyond this general classification it has nothing in common with the numerous other rotary engines which have appeared from time to time, mostly experimental rather than practical.

The advantages of the rotary type of engine have long been recognized, but a stumbling block in arriving at satisfactory results has been the uniform failure to secure steam-tight joints. Chief among the advantages of the type is high piston speed, because the condensation losses due to low piston speed are thereby diminished; but when higher speeds were tried it was invariably found that friction packing was unsatisfactory.

The Warren engine does away with friction packing entirely. In its place is substituted a condition which the inventor describes as "contact without pressure" and hence without friction. A convenient illustration of this principle is afforded by the operation of an ordinary rotary surface grinder. As soon as it ceases to be fed downward or pressure ceases to be applied abrasion ceases; but the wheel continues to revolve smoothly and without friction at such an infinitesimal distance from the object, that, speaking in general terms, it may be said to "touch" it. At any rate, this inappreciable interval provides a joint through which no foreign substance can pass even though that substance might be a gas or vapor under high tension. Furthermore, it is obvious that this condition may be maintained indefinitely, any settling of the wheel due to the gradual wear of the bearings being compensated by a corresponding wearing away of the object with which it is in contact.

If this condition of contact without friction, heat or perceptible wear can be maintained in the case of a rough wheel of abrasive material, the condition will naturally be vastly bettered when hard-polished metal is substituted. That this may be done in the case of a rotary engine is the claim of Mr. Warren, and the details of the mechanism will later be made public.

The Warren engine will be built by the Rotary Engine Company, of Philadelphia, of which Mr. C. E. Wilson, general manager of the Keystone Telephone Company, of Philadelphia, is president. Mr. E. C. Warren, the inventor, is vice-president and Mr. W. P. Tarrant secretary and treasurer. Among the other directors is Dr. Louis Duncan, of the Massachusetts Institute of Technology.

The Nernst Lamp in a New Bank.

The Farmers' National Bank Building, which is to be the largest structure in Pittsburg and one of the tallest office buildings in the world, is nearing completion and will be occupied early in March. Contracts for the electrical apparatus have been signed and most of the apparatus is already in place. The generating plant, consisting of three 150-kw and one 75-kw machines, has been furnished by the Westinghouse Electric & Manufacturing Company, and the building has been wired by Clark & McMullen, of New York. The lighting contract was the most hotly contested of any in the building, and the outcome is that the entire building is to be lighted with Nernst lamps made by the Nernst Lamp Company, of Pittsburg, and supplied by the Doubleday-Hill Electric Company of the same city.

Alden & Harlow, the achitects for the building, decided on the lamp because of the beautiful quality and steadiness of the light, the absence of shadow and the high efficiency. There are to be installed 1,000 55-kw single glower, 1,250 88-kw single glower, 20 2-glower and 20 6-glower lamps, and although different units will prevail in the building, the quality of light will be the same throughout, this being one of the features of Nernst lamp illumination in distinction from the combination of arc and incandescent lights ordinarily found in large interiors.

A New Telephone Receiver.

A new telephone receiver has recently been put on the market by the International Telephone Manufacturing Company, Chicago. The accompanying cuts show the instrument as used, and its working parts. It has a horseshoe magnet constructed in one piece of the very best magnet steel obtainable for the purpose and of sufficient length and weight to secure the strongest magnet possible for an instrument of its kind. The magnet is fitted at its pole ends into the adjusting block and firmly clamped to the bobbins and block by a heavy binding bolt and nut.

The diaphragm is firmly clamped to a metal head by a threaded metal ring, to give it the greatest possible freedom to vibrate, and so it does not depend on the rubber cap for its permanency. Its double-pole pieces are made of a special grade of soft Norway iron, thoroughly insulated and wound with silk-covered magnet wire.

The cores are swaged under heavy pressure in a special die to make them absolutely uniform in width and provide positive stops for the spool heads. The ends are milled perfectly square in a special jig, making them all of one length. The spool heads are mounted and set to the cores by machine in a special tool, to give the bobbins all the same spacing. The spools all being absolutely of one shape and size in every way, makes them interchangeable at all times. The cores fit tightly into the adjusting block, making it impossible for the receiver accidentally getting out of adjustment.

It is adjustable, so that the diaphragm and pole pieces of every instrument may be placed in their exact, proper relations with each other, to secure the best possible results for the service desired. The spools being practically the only working part of a receiver that are subject to being destroyed or naturally becoming defective, the International Receiver is made adjustable so this part may be conveniently and readily replaced and the receiver accurately and permanently adjusted without returning the entire instrument to the factory. It has all working parts self-contained and has no part

FIG. 1.—RECEIVER COMPLETE.

depending on the shell or cap for being held in place. Its magnet is fastened at its pole end only, so that the receiver is not affected by any difference between the contraction and expansion of the rubber shell and of the magnet steel, from extreme variations in temperature.

The magnet, together with the spools, are securely fastened into a strong cast brass threaded adjusting-block, which is fastened into a metal cup. The diaphragm is clamped firmly to the edge of this cup by a finely threaded metal rim. The adjustment is locked by two binding screws passing through slots in the cup, firmly clamping it to the adjusting block. All working parts being of metal and securely held in position near the diaphragm, make the adjustment absolutely unchangeable.

Every detail part is made strong and durable. The shell which in itself is of extra thickness, has no strain or weight to hold. The shell is only a cover to the working parts. The receiver can be used without its shell. The cap of the receiver is provided with a small ridge around the hole, so that perspiration, due to long use of the instrument in hot weather, will not enter and rust the diaphragm. The shell and cap are constructed of polished hard rubber. The coil wires are of silk-covered magnet wire and lead through

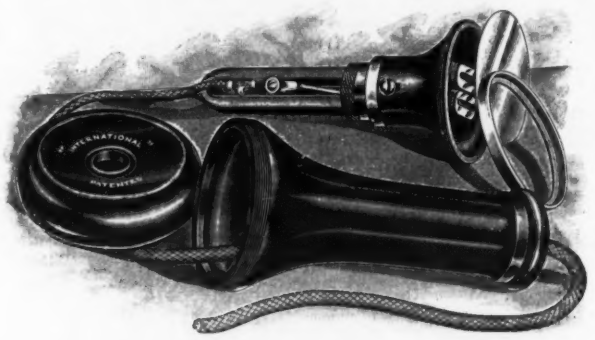


FIG. 2.—DETAILS OF RECEIVER.

sleeving direct to the cord terminals, avoiding chance of loose connections or open circuit in the receiver head.

The cord terminals are mounted upon an insulating block, placed between the magnet bars. They are provided with a special cord clip to hold the cord by its braid and relieve the conductors of all strain. The outer ends of the cord are regularly furnished with a loop to fasten under a binding screw. They are provided with the ordinary cord tips if desired, and so ordered.

This receiver has all metal parts and cord terminals entirely concealed within its rubber shell and cap. There is positively no danger of getting an electrical shock from the receiver while using the instrument, in case of lightning or trolley crosses on the outside lines.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered liberally and there was a fair demand. The closing rates were 4¼ per cent. for 60 to 90 days, and 4¼ a 4¾ for 4, 5 and 6 months. The stock market showed less activity, as a result of the holiday Thursday. The volume of business, however, was fairly large and the general tone was strong. A great deal of attention was paid to large increases which have continued to be shown in railway earnings and also to the general favorable condition of business and of manufacturing industries, which latter is reflected by the increased attention paid to the various securities on the industrial list. More or less effect was produced by the continued indication of improvement in the copper market and the inception of active manipulation, not only in Amalgamated Copper, but in the various other copper stocks traded in either at New York or Boston. Amalgamated Copper rose from 68¾, to 71. Among the tractions, Brooklyn Rapid Transit became conspicuous upon talk about improved earnings under the new management. This stock closed at 69¼ after having reached 70½, the sales aggregating 53,060 shares. The closing price represents a net gain of ⅜ of a point. Metropolitan Street Railway closed at 138, being a net gain of 1 point, this quotation being ½ point below the highest price of the week. General Electric scored another sharp advance in connection with the expected "rights" to be issued against new stock used for the purchase of the Stanley Electric Company. It closed at 202⅜, being a net gain of 8⅝ points. The sales were 15,600 shares, the range of prices being 193¾, the lowest, and 204 the highest. Westinghouse, both issues, showed gains, common closing at 218, being 4¼ points higher than last quotation, and preferred 202, being a net gain of 2 points. Western Union was steady throughout the week, closing at 90, which is practically unchanged from last week. American District Telegraph closed at 38½ and American Telegraph and Cable at 84¾. Following are the closing quotations of February 17:

NEW YORK.

	Feb. 10.	Feb. 17		Feb. 10.	Feb. 17
American Tel. & Cable	85	84	General Electric	195¼	200
American Tel. & Tel.	164	165	Hudson River Tel.	..	..
American Dist. Tel.	37	37	Metropolitan St. Ry.	137¾	139¼
Brooklyn Rapid Transit	69¼	70¼	N. E. Elec. Veh. Trns.	3/16	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	162	..
Electric Boat	20	20	N. Y. E. V. T. Co.	10	10
Electric Boat pfd.	37	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3	Western Union Tel.	89⅛	90
Electric Vehicle.	6	6¼	Westinghouse com.	210	217*
Electric Vehicle pfd.	11¼	11⅜	Westinghouse pfd.	210	220*

BOSTON.

	Feb. 10.	Feb. 17		Feb. 10.	Feb. 17
American Tel. & Tel	164¾	165⅛	Western Tel. & Tel. pfd.	99	..
Cumberland Telephone	..	..	Mexican Telephone	2¼	2¼
Edison Elec. Illum.	..	305	New England Telephone	135	..
General Electric	194¼	200¼	Westinghouse	105	104
Western Tel. & Tel.	24	25¼	Westinghouse pfd.	105	105

PHILADELPHIA.

	Feb. 10.			Feb. 10.	
American Railways	..	Election Day.	Phila. Traction	98	Election Day.
Elec. Storage Battery	..		Phila. Electric	8	
Elec. Storage Battery pfd.	..		Pa. Electric Vehicle	..	
Elec. Co. of America	9¼		Pa. Electric Vehicle pfd	..	

CHICAGO.

	Feb. 10.	Feb. 17		Feb. 10.	Feb. 17
Central Union Tel.	..	..	National Carbon pfd.	98	98
Chicago Edison	160	162	Northwest Elev. com.	..	..
Chicago City Ry.	225	220	Union Traction	10¾	10
Chicago Tel. Co	..	157	Union Traction pfd.	35	45
National Carbon	24	25			

*Asked.

CONSOLIDATION AT LOUISVILLE.—A merger of the Louisville Railway Company, the Louisville Gas Company, and the Louisville Electric Light Company and the Citizens' General Electric Company, is said to be on foot. A conference was held last week. There were present J. B. Speed, vice-president of the Louisville Railway Company, with large interests in this corporation and the Louisville Gas Company; Udolpho Snead, president of the Louisville Gas Company; A. Hite Barret, president of the Louisville Electric Light Company, and Harry Bishop, vice-president; J. J. Harbeson, president of the Citizens' General Electric Company, and A. M. Worthington, secretaries; W. T. Sheehan, New York; Thomas E. Murray, Brooklyn, and John Hourigan and R. B. Lewis, of Albany. The Louisville Railway Company, the Louisville Electric Light Company, and the Citizens' General Electric Company are now maintaining separate power plants, and under a merger of interests these would be combined, thereby effecting a big saving of operating expenses.

NEW ENGLAND TELEPHONE.—At the meeting of the directors of the New England Telephone & Telegraph Company the statement of the business of the company for the year 1902 was presented. It shows gross revenue of $6,024,609, against $5,177,412 in 1901 and $4,518,396 in 1900; operating expenses of $4,855,840, against $4,139,929 in 1901 and $3,621,644 in 1900, making the net revenue in 1902 $1,168,769, against $1,037,482 in 1901 and $896,752 in 1900. The dividends (6 per cent.) in 1902 were $1,108,726, against $947,406 in 1901 and $838,635 in 1900. The surplus for 1902 was $60,042, against $90,076 in 1901 and $58,117 in 1900. The capital stock sold during 1902 amounted to $3,593,200 and the total stock outstanding at the end of 1902 was $21.616,700. The number of exchange stations open was 111,774; increase in stations during year, 17,952.

DIVIDENDS.—The directors of Niles-Bement-Pond have declared the usual semi-annual dividend of 4 per cent. on the common stock, one-half (2 per cent.) payable March 20, and one-half payable June 20. The directors have also declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable February 14. A 2 per cent. semi-annual dividend has been paid on the $100,000 of preferred stock of the New Albany (Ky.) Street Railway, the first dividend since reorganization. The Metropolitan Elevated, Chicago, has declared the semi-annual dividend of 1½ per cent., making 3 per cent. for the year, payable February 28th. The American Railways directors have declared the quarterly dividend of 1½ per cent., payable March 16, to stock of record February 28.

GENERAL ELECTRIC-STANLEY.—The much-discussed deal between the General Electric and Stanley interests has, it is said, been closed, but does not include the Electric Storage Battery Company, as was expected by some people, and even announced in the daily papers. The price for the Stanley shares is understood to be somewhere in the vicinity of $120—$125. The large factory at Pittsfield will be carried on as usual and the Stanley Company will continue to devote its energies chiefly to high-voltage polyphase apparatus for which it has won a deservedly high reputation. For the present also no change, it is said, is to be made in the personnel of the management or the technical and selling organization.

NORTHWESTERN ELEVATED, of Chicago, reports for the year ended December 31 as follows:

	1902.	1901.	Changes.
Gross	$1,410,998	$978,766	Inc. $432,232
Expenses	464,401	322,645	Inc. 141,756
Net	$946,597	$656,121	Inc. $290,476
Charges and tax	757,173	400,693	Inc. 356.480
Surplus	$189,424	$255,428	Dec. $66,004
Previous surplus	282,305	.....	.....
Total surplus	$471,729	.....	.....

CLEVELAND INDEPENDENT TELEPHONE.—The Cuyahoga Telephone Company, of Cleveland, Ohio, reports as follows for the year ended December 31, 1902: Gross, $385,852; expenses and taxes, $229,709; net, $156,143; charges, $155,600; surplus, $543. The general balance sheet as of December 31 shows: Assets—Property and plant, $5,714,243; material and supplies, $60,616; current assets, $101,724; deferred assets, $1,756; deficit, $29,143; total, $5,907,482. Liabilities—Capital stock, $3,000,000; bonded debt, $2,233,000; current liabilities, $196,046; Federal Telephone Company, $475,393; deferred liabilities, $3,043; total, $5,907,482.

SOUTH JERSEY ELECTRICS.—The stockholders of the South Jersey Gas, Electric & Traction Company will vote on February 28 on a proposition authorizing the issue of $15,000,000 of bonds of which $8,200,000 will be used to retire existing bonds at maturity. The stockholders of the company, which is supposed to be dominated by United Gas Improvement interests, will also vote on merging eight companies into its organization.

COLORADO TROLLEYS.—According to Denver dispatches the Florence and Kenton City Electric Street Railway has filed a mortgage to secure $2,700,000 5 per cent. twenty-five-year gold bonds, and will build 125 miles of electric railway throughout the region.

MINNEAPOLIS GENERAL ELECTRIC.—The Minneapolis General Electric Company will hold a stockholders' meeting February 20 for the purpose of increasing the preferred stock by $250,000, making the total issue $1,000,000.

PITTSBURG BELL TELEPHONE.—The capital stock of the Central District Printing & Telegraph Company has been increased from $1,250,000 to $10,000,000.

BOSTON EDISON BRANCHING OUT.—The Edison Electric Illuminating Co., of Boston, will shortly petition the gas commissioners for authority to issue new stock to capitalize recent purchases of suburban electric properties. Five companies have already been absorbed, and others will probably be gathered in before the filing of the petition. The companies already acquired, the capitalization and the floating debts follow:

	Capital stock.	Bonds & notes.	Floating debt.
Dedham Electric	$60,000	$93,000	$21,000
Blue Hill Electric	30,000	.....	63.000
Milton Light & Power	42,000	69,000	12,000
Natick Gas & Electric	62,000	62,000	98,000
Framingham Electric	80,000	50,000	56,000
Total	$274,000	$274,000	$250,000

The extent of the new stock issue will depend upon the appraised valuation of the several plants purchased.

ALBANY & HUDSON.—At the Court House at Hudson, N.Y. on February 11, the property of the Albany & Hudson Railway and Power Company was offered for sale and was bid in by Charles H. Warner, representing Sheehan & Collins, attorneys for the Colonial Trust Company of New York, holders of the mortgage of $2,500,000. There was only one bid—$1,250,000—just one-half the amount of the mortgage. This sale includes all of the company's property in Columbia and Rensselaer Counties, the gas plant in Hudson, the electric power house at Stuyvesant Falls, Electric Park, and the Hudson Railway. The company has been unable to pay interest since the serious accident two years ago, in which several lives were lost. The road will be reorganized and continued under new management. It is a splendid property and will rapidly recuperate from the disasters inflicted upon it by careless motormen.

NORTH AMERICAN.—The Board of Directors of the North American Co. has declared a dividend of 4 per cent. upon the capital stock of the company, payable 1 per cent. quarterly on the first days of March, June, September and December of the current year. The dividend thus declared is derived solely from the interest and dividends received by the company from its permanent investments in electric lighting companies, irrespective of the earnings derived from its general operations and business. This is the first dividend in 20 years, and is entirely due to the policy of going into sound electrical enterprises. The original scheme was a branch of the Villard Northern Pacific deals.

STARK ELECTRIC MORTGAGE.—A Youngstown, Ohio, dispatch states that the Stark Electric Company has filed a mortgage for $1,000,000 in favor of the Savings and Trust Company of Cleveland.

Commercial Intelligence.

THE WEEK IN TRADE.—The trade situation throughout the country is summed up by *Bradstreet's* as follows: "Distributive trade and productive industry feel the influence of spring-like weather, slightly better collections, steady and even strong prices for staples, some improvement in the railway transportation situation and cheaper and better supplies of coal at the east." The mild weather has stimulated building operations generally, and highly satisfactory reports are made from the different sections of the country. The prosperity of railways does not seem to have yet culminated, since increased freight rates, based upon higher wages, have brought larger receipts. The net returns for December will turn out better than was expected, while the gross receipts for January this year will prove to be by far the best ever reported in that month. It is pointed out in connection with the industrial situation that present high prices do not seem to check consumption. In the strongest situated industries of all those of cotton manufacturing and of iron and steel production, insistent demand, culminating in large sales, gives testimony to the increased purchasing power of the country at large. In iron and steel the car congestion continues to be the chief obstacle to freedom of trade, the supplies of coke for the furnaces being limited thereby. There is an increased demand for structural material, steel plates, merchant bars and rails. The distribution of hardware is increasing and building operations promise to be very active. The logging output in Maine is very large and an unprecedented activity is noted on the Pacific coast, but the Northwest reports that lack of snow is limiting the output. In the South and Southwest the output of lumber is enormous. In the metal market, copper exhibited great strength and a large business was done for home trade as well as for export. Manufacturers continue very busy. Prices have again advanced, the closing quotations being 12¾ a 12⅞c. for Lake, 12⅝ a 12¾c. for electrolytic in cakes, wire bars and ingots, and 12⅜ a 12½c. for cathodes and casting stock. The number of business failures for the week ending February 12, as reported by *Bradstreet's*, numbered 214 as against 208 the week previous and 265 the corresponding week last year.

THE NEW YORK EDISON COMPANY has recently placed a contract with Westinghouse, Church, Kerr & Co. for another 6,500 hp Westinghouse vertical three-cylinder compound engine of the same size and construction as the eight already in operation and being installed at its 39th Street Waterside Station. This contract includes an independent steam driven air and circulating pump condenser equipment and is the third order received from the New York Edison Company for these engines, the first covering eight units, the second two, and the third one, a total of eleven units, aggregating 71,000 hp normal, or 100,000 hp maximum capacity. The engines are of the vertical type, with a middle high pressure cylinder 43½ inches diameter, and two outside low pressure cylinders each 75½ inches diameter, the stroke being 60 inches. The engines are approximately 40 feet over all in height. They are direct connected to 4,000 kw revolving field generators, supplying high tension polyphase current to the various local sub-stations throughout Manhattan. Steam is supplied at 175 lbs. and a vacuum of 27 inches is maintained by the condensing system. The air and circulating pumps are mounted upon a common bed-plate, together with the actuating Corliss cylinder, forming a pumping unit of great compactness.

WATERWORKS FOR PORTO RICO.—The Stilwell-Bierce & Smith-Vaile Company, through Mr. George W. Neff, Washington Life Building, have secured a contract from Vicente Usera, of Ponce, Porto Rico, for a complete waterworks system. There will be two compound pumping engines having a combined capacity of 5,000,000 gallons. The boiler plant will consist of three 150-hp units. Four hundred tons of cast-iron water pipe, varying from 6 inches to 14 inches in diameter, have also been requisitioned for. The value of the contract exceeds $60,000.

LARGE POWER PLANT FOR PERU.—A large plant is to be constructed in Peru for the purpose of operating the smelter works —not yet built—at the Cerro de Pasco copper mines, which are controlled by American interests in which J. B. Haggin, Mills Building, is one of the leading spirits. The capacity of the power plant will be 5,000 hp. Mr. Frank Klepetko, consulting engineer, whose offices are in the Maritime Building, Bridge Street, is now in Peru regarding the matter. He is expected to return in about three weeks.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company's instrument statement for the month ended January 20, shows:

	1903.	1902.	Changes.
Gross output	129,837	87,412	Inc. 42,425
Returned	43,286	34,796	Inc. 8,490
Total output	86,551	52,616	Inc. 33,935
Total outstanding	3,236,871	2,578,626	Inc. 658,245

MEXICAN HYDRAULIC PROJECT.—Lauro Barra, of Mexico City, has been granted a concession by the Mexican authorities for the purpose of constructing an hydraulic plant on the Del Valle River, located in the State of Mexico, at a point called Salitrillo, about 45 miles west from the City of Toluca. The franchise permits of the use of 8,000 liters of water per second. The power is to be used for furnishing electric energy in the vicinity.

BIG BUENOS AYRES TRAMWAYS TO BE ELECTRIFIED.—The Tranvia Cuidad de Buenos Aires—the Buenos Ayres Tramway Company—which concern at present operates 36 miles of animal lines in the Argentine capital, is about to seek permission from the municipality for converting the system over to electric traction. The company is a British one, with head offices at 1 Great Winchester Street, London, E. C.

THE DRAVO CONTRACTING CO., Pittsburg, Pa., is building for Mr. Harry Oliver at Pittsburg, a large and complete electric plant for furnishing electric light and power for the Lewis Block and surrounding buildings. The plant is to consist of three 400 hp vertical cross compound engines, direct connected to Westinghouse generators. The engines are built by the Ball Engine Company, Erie, Pa.

LARGE RIO LIGHTING PLANT.—The Rio de Janeiro Gas Company is primarily interested in a project to establish an extensive electric light plant in that Brazilian city. Mr. J. B. Orr, of the electrical engineering and contracting firm of James Mitchell & Co., Rio Janeiro, is expected to bring further data with him when he visits New York shortly.

ELECTRIC LIGHTING AND TRACTION FOR CORDOBA.—An electric light plant is to be built in the City of Cordoba, Argentine Republic. The construction of an electric traction system is also projected. A Mr. Ross is primarily interested in the schemes.

ST. LOUIS FAIR BOILER PLANT.—The contract for erecting the great boiler plant of the World's Fair has been awarded to the American Bridge Company, of St. Louis, for $100,000. The structure will be constructed of steel frame. It will stand just west of Machinery Hall and the main approach to the Midway. Between twenty and thirty boilers will be housed there. They will consist of boilers of various capacity, to be furnished as exhibits by boiler-making firms in every part of the world. The first exhibit boiler, one sent by a firm at Duesseldorf, Germany, is already on the grounds awaiting the completion of the plant. Power furnished by the boilers will be supplied to the generators and dynamos in the western end of the Machinery Building. These electrical engines will be placed in the building as live exhibits by their makers and will supply at least two-fifths of the electric power used on the site. The current will be carried to various parts of the grounds by the electric subway, already constructed. Three-fifths of the total power will be furnished by the Citizens' Electric Light Company.

MORE STEAM TURBINES FOR HARTFORD.—The steam turbine equipment of the Hartford Electric Light Company, Hartford, Conn., is to be duplicated in the near future by machines manufactured by the builders of the original installation, the Westinghouse Machine Company, Pittsburg, Pa. The present Corliss engine equipment will be replaced by two 1,000-hp turbines, direct connected to revolving-field polyphase generators. These units will operate in parallel with the 1,500-kw unit installed one year ago, and were chosen for the purpose of securing the utmost flexibility and economy in the operation of the plant. The turbine plant will operate upon superheated steam, with 150 pounds pressure and a high vacuum. The original installation created much interest among engineers and power users, and it is interesting that the first American turbine of large size has given such satisfaction as to warrant an extension of the turbine equipment and the relegation of the steam engine, after one year's operation.

ELECTRIC CRANES FOR CANADIAN LOCOMOTIVE SHOPS.—The Montreal Locomotive & Machine Company's new plant about to be constructed in Montreal, Canada, is to be equipped with electric traveling cranes, to be built by the Whiting Foundry Equipment Company, of Harvey, Ill. Edward J. Etting, of 26 Cortlandt Street, who represents the Whiting interests in New York State, outside of Buffalo, and in Eastern and Central Pennsylvania, has just taken a contract for a 20-ton crane to be installed in the Paxtang Electric Company's plant at Harrisburg, Pa. The Mishawaka (Ind.) power station is also to be equipped with a Whiting crane of similar capacity. This order was taken through the engineering and contracting firm of Sanderson & Porter. A 60-ton crane, to be operated by Westinghouse motors, has been ordered by the Southern Electric Company, of Philadelphia.

NEW YORK CENTRAL IMPROVEMENTS.—The New York Central & Hudson River Railroad has recently placed an order with Westinghouse, Church, Kerr & Co. for four Westinghouse-Corliss engines of the horizontal cross compound type. These engines will form the main power equipment of a new power station in process of erection on the company's property at Weehawken, N. J., which will supply power to the grain elevators and shops there located. Two of the engines are 1,200 hp normal capacity and the remaining two of 700 hp, each pair being direct connected respectively to 750 and 400 kw polyphase generators of the revolving field type. They will operate with 140 lbs. of steam, superheated to 500 degrees Fahrenheit, and with high vacuum. The equipment also includes a small exciter engine of the Westinghouse vertical compound type.

EQUIPMENT FOR NORTH BEACH PLANT.—The Bowery Bay Electric Light & Power Company, of North Beach, L. I., whose president is Walter C. Foster, of the law firm of Foster & Foster, 132 Nassau Street, New York, has placed a contract with Thayer & Company, Incorporated, 39-41 Cortlandt Street, for four Cahall boiler units of 266 hp each. The electric plant consists of Stanley generators operated by engines built by the Buffalo Forge Company and Armington & Sims. The plant which generates power for the purpose of lighting North Beach and operating the steam circuses at that seaside resort will very shortly be extended. The present capacity of the plant is 1,000 hp.

THE A. A. McCREARY COMPANY, 136 Liberty Street, New York, manufacturer of the well-known McCreary half shades, reflectors, desk lamps, etc., and the oldest electrical specialty house, has been reorganized as the McCreary Electric Company, as already noted. The new company has increased facilities for the prompt manufacture and delivery of electrical goods, and will materially enlarge its line. It will be represented in Chicago, London and the Continent. A. A. McCreary, who has been identified with the electrical business for the past twenty years, will be retained as president. Henry W. Brooks, Jr., of 44 Pine Street, New York, is treasurer.

POWER DAM FOR ST. CROIX RIVER.—Plans for a proposed dam in the St. Croix River, between Taylor's Falls and St. Croix Falls, which are before the War Department for consideration, have been endorsed by Major R. L. Hoxie, government engineer, stationed there. Major Hoxie has been in consultation with engineers representing St. Croix River interests, and has found that they have no objection to the proposed dam. The water is to be used for the purpose of generating electric power.

THE PHILADELPHIA TAPESTRY MILLS, manufacturers of tapestries and light carpeting, two years ago decided to operate their plant throughout by electric power and for that purpose purchased (on recommendation of their consulting engineer, Dr. Drysdale), a 150 kw Westinghouse two-phase engine-type alternator, together with some 12 to 15 induction motors. This plant has given such satisfaction that they have now decided to duplicate it and have recently contracted with the Westinghouse Company for another alternator of the same size.

POWER TRANSMISSION PLANT FOR INDIA.—The Federal Electric Company, 141 Broadway, New York, has taken a contract for the complete electrical equipment of a transmission plant to be constructed in India for the purpose of generating energy to be conveyed a distance of about 20 miles for both light and power use. There will be two 150-kw, 3-phase generators. The contract for the steam equipment has been awarded to a British concern on the plea of better prices and deliveries being obtained there at present.

POWER PLANT DEVELOPMENT.—Mr. J. H. Robeling has completed the plans for the development of a water-power electrical plant at old Limekiln Falls in the town of Stockbridge, N. Y. The plans provide for two plants, one above the other, thus using the water twice, and the combined plants will furnish 2,000 hp. It is proposed to use the upper power house for supply for Syracuse and the one on the flats for the use of Oneida and Canastota. Mr. Dewitt Hadcock, of Oneida, owns the water rights.

BALL ENGINE ORDERS.—The Woman's College, Baltimore, Md., has recently purchased from the Ball Engine Company, Erie, Pa., a 160-hp self-oiling engine, arranged for direct connection to a 100-kw General Electric generator. Strauss, Eisendrath & Co., Clinton and Quincy Streets, Chicago, have recently installed a 175-hp direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine and the Western Electric Company the generator.

WHITEHEAD MACHINERY COMPANY, of Davenport, Ia., has purchased some 1,500-hp Babcock & Wilcox water tube boilers, from Benedict & Burnham Manufacturing Company, of Waterbury, Conn., and has also purchased 1,000-hp Heine water tube boilers from the L. Hoster Brewing Company, of Columbus, Ohio. Both plants will be dismantled at once. The changes, in both instances, are due to radical alterations and enlargements.

DE FOREST WIRELESS.—Since the adoption of the De Forest system by the United States Navy negotiations have been instituted which will probably result, it is claimed, in its adoption by the Clyde, Mallory and Ward Line of steamships, and by the line running from New York to Porto Rico. The United Fruit Company announces that it has made an agreement with the De Forest Company respecting two stations to be established.

THE DODGE COLD STORAGE COMPANY, of Philadelphia, is building a large coal handling crane to be installed at the Maryland Steel Company's plant at Sparrow's Point. This crane will be driven by electric motors, and the Dodge Company has recently purchased for this purpose one 50-hp and two 30-hp direct-current motors with controllers from the Westinghouse Electric & Manufacturing Company.

THE ALLIS-CHALMERS COMPANY, amongst other large orders for January, reports the sale to the St. Louis & Suburban Railway Company, of St. Louis, Mo., of one 30 x 50 x 60 cross-compound Reynolds-Corliss engine and two 32 x 60. The United Engineering & Contracting Company, of New York City, has ordered two 18 x 42 horizontal Reynolds-Corliss engines.

BULLOCK CONTRACT FOR TROLLEY PLANT.—The Scioto Traction Company, of Columbus, Ohio, has awarded the contract for all the heavy electrical machinery for its power house and substations to the Bullock Electric Manufacturing Company, of Cincinnati. The work will cost about $100,000.

MACHINE TOOLS FOR JAPANESE GOVERNMENT RAILWAY.—Frazar & Co., of Japan, at 63-65 Wall Street, have secured a contract for double-axle lathes, treble-geared turret lathes and other American machine tools for installation in the Japanese Government railway shops.

ORDERS PENDING FOR SMALL BRAZILIAN PLANT.—The Brazilian export house of Blytton Brothers is after contracts for several small plants, which are to be erected for lighting villages along the upper section of the Amazon River and in other parts of South Brazil.

General News.

THE TELEPHONE.

BATESVILLE, ARK.—The Newark Telephone Company, of Batesville, Ark., has filed articles of incorporation. The capital stock is $10,000, of which $5,000 has been subscribed. C. J. Magness is president, J. S. Hanford, vice-president and treasurer, and J. C. Yancy, secretary.

SAN FRANCISCO, CALIF.—The Mission Long Distance Telephone Company has been incorporated with a capital stock of $1,000,000. The directors are G. K. Brown, J. J. Scrivner and others.

DENVER, COL.—The Rifle Creek Telephone Company has been incorporated by C. J. Hoover, R. Parris, G. E. Clarkson and others. Capital $60,000.

WASHINGTON, D. C.—The Chesapeake and Potomac Telephone Company has awarded a contract for the construction of a $200,000 telephone exchange building to be erected in Twelfth Street. C. L. W. Eidlitz and Andrew McKenzie are the architects.

ROCHELLE, ILL.—The Ogle County Telephone Company has increased its capital stock from $60,000 to $100,000.

CALEDONIA, ILL.—The Boone County Co-operative Telephone Company has increased its capital stock from $7,500 to $15,000.

MOUNT VERNON, ILL.—A new telephone company was formed a few days ago at Idlewood. Its line will run from Mount Vernon via Idlewood to Range. There will be twenty stockholders in the company and each one will have a telephone.

ALTON, ILL.—The Kinloch Telephone Company has completed a 664-mile stretch of wire, which gives direct connection with Terre Haute and Indianapolis, Ind., from Alton. Another line from St. Charles to Kansas City has been completed recently.

SPARTA, ILL.—A representative of the Mutual Telephone and Telegraph Company will appear before the City Council of Sparta, the first Monday in March and ask for a general telephone franchise. There is also a representative of a private corporation in St. Louis who will appear before the City Council at the March meeting and ask for a general franchise.

EDWARDSVILLE, ILL.—Another rural telephone company has been organized by prominent farmers of the bottom south of this city, officers being elected as follows: President, John Feldman; vice-president, William Dickman; secretary, J. F. Dickman; treasurer, August Brockmeier; directors, Edward Brockman, Henry Viere, Chris Rathert, August Klingeman, Ed Kramer and August Stegmeier. Contract for poles, wires, etc., will be let at an early day.

LAFAYETTE, IND.—The Salem Co-operative Telephone Company has been incorporated at Lafayette, with a capital of $600.

GREENCASTLE, IND.—An ordinance was passed granting the Putnam County Co-operative Telephone Company a franchise for a telephone system in this place.

THOMAS, I. T.—A local telephone system was put in operation here Feb. 1 with 75 telephones. The owners of the system are Riley, Mitchell & Co., of Clay City, Mo. Five months ago Thomas was a wheatfield and to-day it is a booming town on the new Frisco extension from O'Keene to Vernon, Tex.

NEVADA, IA.—The Short Line Telephone Company has been incorporated with a capital of $5,000. F. M. Boardman is president.

WATERLOO, IA.—The Commonwealth Telephone Company, a new corporation, has acquired the lines of the Cedar Valley Telephone Company, the County Telephone and Telegraph system, the Waverly Telephone Company, Hardin County Company, Parkersburg and La Porte systems, all of which have been closely affiliated with the Cedar Valley system. The capital of the company is $900,000, and its principal place of business will be Waterloo.

MT. STERLING, KY.—The Eastern Kentucky Telephone Company, of Montgomery County, has filed incorporations at Frankfort. The capital is $25,000 and the incorporators are R. D. Wilson, Henry Watson and Dr. J. A. Shirley.

SALISBURY, MD.—At the annual meeting of the stockholders of the Maryland and Delaware Telegraph and Telephone Company the expenditure of $150,000 for building of the lines in Virginia was passed upon favorably.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, Grand Rapids, Mich., has recently purchased a 160-capacity, 100 equipped generator call switchboard for Traverse City, Mich., from the Stromberg-Carlson Telephone Mfg. Co.

HUTCHINSON, MINN.—The stockholders of the Hutchinson Telephone Exchange Company have elected the following named officers and directors: President, W. E. Harrington; vice-president, W. S. Clay; secretary, H. L. Merrill; treasurer, Wm. Davidson. Directors: W. E. Harrington, W. S. Clay, H. L. Merrill, Wm. Davidson, D. S. Sivright, W. E. Sivwright and C. G. Odquist.

SAVANNAH, MO.—The Haynie Telephone and Manufacturing Company of this city has been incorporated with a capital of $15,000, one-half paid. The incorporators are George A. Haynie, James Huston and Leslie N. Fry.

DARIEN, N. Y.—The Rural Telephone Company of this place has decided to extend its line.

BERGEN, N. Y.—The Bergen Telephone Company has applied for a franchise. M. Gillette is president.

PENN YAN, N. Y.—The Pulteney-Branchport Telephone Company has been incorporated. The capital stock of the company amounts to $1,000. The line has been in operation for some time.

CANAAN, N. Y.—The Canaan & Chatham Co-operative Telephone Co., of Canaan, Columbia County, has been incorporated; capital, $1,000. Directors: A. B. Howes, F. C. Goodrich, Sr., and O. D. Bartlett, of East Chatham.

ALBANY, N. Y.—The Edmeston and Winfield Telephone Company, of West Exter, Otsego County, has been incorporated, capital $2,000. The directors are D. J. Wood, E. L. Morris and J. B. Wolcott, of West Exter.

HOOSICK FALLS, N. Y.—The Eastern New York Telegraph and Telephone Company, of Hoosick Falls, N. Y., has made a five years' contract with the Rensselaer Telephone Company, of Troy, for the interchange of toll business.

NEW YORK, N. Y.—Plans have been filed with the Building Bureau for the enlargement of the three-story and basement telephone exchange at 30 East Twenty-ninth Street by the addition of a four-story and basement annex on the adjoining lot, doubling the present size of the exchange. The improvement is to cost $80,000.

CLEVELAND, OHIO.—The Empire Telephone Company, of Cleveland, has increased its capital stock from $200,000 to $500,000.

WELLINGTON, OHIO.—The Wellington Telephone Company has 360 telephones, a gain of 120 within a year. The company will connect up a number of farmers and will build a line to New London the coming summer.

HANNIBAL, OHIO.—The Hannibal & Roundbottom Telephone Company has been incorporated, with $10,000 capital stock, by J. A. Fraley, J. W. Fraley, S. W. Fraley, John Ruby and G. Youssy. It will build a system at Hannibal, Monroe County .

DELAWARE, OHIO.—The Citizens' Telephone Company has just completed the installation of a Stromberg-Carlson multiple central energy board of 3,200 lines capacity. The company is extending its system into the surrounding farming districts. Guy Kingsbury is manager.

COLUMBUS, OHIO.—The Franklin County Telephone Company has over 1,200 subscribers in Franklin County, outside of the city of Columbus. It is planning to erect a new exchange in the only town in the county not covered at present. The farmers' system is to be extended during the coming summer.

MARION, OHIO.—The Marion County Telephone Company has 1,075 subscribers in this county. It is installing a new 50-line board at Green Camp, a 100-line board at La Rue and a 50-line board at Agosta. It is planning to build two additional exchanges in other towns and will also build a large number of farmers' lines during the summer.

SANDUSKY, OHIO.—The Sandusky Telephone Company has elected the following named directors: L. Duennisch, J. Kuebler, J. C. Hauser, J. A. Geideman, C. C. Curtiss, J. A. Beihl, C. H. Cramer, L. L. Curtis, C. L. Engel, J. W. Holland, Sidney Kilbourne, C. A. Rittman, John Sinerson and John Whitworth. The company will make a number of improvements during the coming summer.

TOLEDO, OHIO.—The Toledo Home Telephone Company has made application to Probate Judge Miller for a modification of its franchise so as to permit the company to increase its rates. It is claimed the company expected only to secure about 3,500 subscriptions whereas it now has 6,500 subscribers, with many more on a waiting list. At present all contracts are being made on a basis of three years at existing rates.

LEBANON, OHIO.—The Valley Telephone Company has 450 subscribers, a gain of 134 within a year. It is installing a new American Electric board which connects up 350 farmers' lines outside the main exchange. During the coming summer it will erect 8,500 feet of cable and will build branch exchanges at Franklin and Middletown. The board for the former will have 300 lines and for the latter 1,000 lines. None of this material has been purchased.

ALTOONA, PA.—The United Telephone and Telegraph Company, of Philadelphia, has planned to spend $250,000 in this vicinity this spring and summer.

PHILADELPHIA, PA.—The Keystone Telephone Company, of Chester, has joined with the United Telephone Company, and will have service in Pennsylvania, Maryland, Virginia and West Virginia.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, is said to have made a 60 per cent. increase in the number of telephones in the year 1902, the list of stations in service in Philadelphia increasing from about 25,000 to 40,000.

McKINNEY, TEX.—The McKinney Telephone Company has sold its property to the Southwestern Telegraph & Telephone Company.

AMARILLO, TEX.—The Amarillo Telephone Company has been incorporated. Incorporators: R. G. Steyman, R. L. Stringfellow and J. C. Smith, all of Amarillo.

MARSHALL, TEX.—The city council granted a franchise to an independent telephone company. The franchise is forfeited if ever sold to the Bell Telephone Company.

GAINESVILLE, TEX.—The Gainesville Telephone Company, of this city, has been incorporated with a capital stock of $100,000. The incorporators are F. B. McElroy, Sidney L. Samuels and Geo. D. Winters.

COUPEVILLE, WASH.—The Eclipse Telephone Company has elected directors for the ensuing year. The officers are F. A. LeSourd, president; C. T. Terry, vice-president; O. S. Van Olinda, secretary; A. W. Cook, treasurer.

APPLETON, WIS.—The Appleton & Freedom Telephone Company has been organized with a capital of $1,200 to build a telephone line between Appleton and North Freedom.

MADISON, WIS.—The Badger Telegraph & Telephone Company, of Milwaukee, has been incorporated with a capital stock of $150,000 by Charles A. Russell, H. J. Droppers and E. L. Richardson.

FOND DU LAC, WIS.—The Little Wolf Telephone Company has under consideration a proposition from a party of Wisconsin capitalists looking to the extension of its lines throughout the State. The plan is to enter into an agreement with the independent companies of the State whereby connections may be made through the Little Wolf, thus forming one of the most complete telephone systems in Wisconsin. It is proposed to make the line a complete copper circuit.

ELECTRIC LIGHT AND POWER.

CLAYTON, ALA.—This town will soon receive bids for putting in electric lights and water works. It has just finished an artesian well, and when this is put into operation it will proceed to attend to the light question.

WASHINGTON, D. C.—The Potomac River Power Company is reported organized, with J. F. McLaughlin, of Toronto, Ont., as president, to erect buildings necessary for the establishment of a large water power plant near Washington.

SMYRNA, DEL.—The Town Council will borrow $6,000 for improvements of the electric light and water plants.

MONROE, GA.—An electric light plant will probably be constructed this year, but no definite arrangements have yet been made. L. S. Radford is city clerk.

ATLANTA, GA.—O. H. Sheffield & Co., Atlanta, have purchased water rights on Savannah River in Elbert County. About 5,000-hp will be developed and transmitted to factories in the vicinity. The improvements are estimated to cost about $300,000.

DECATUR, ILL.—R. E. Pratt and others have been granted the right to establish an electric light plant in Decatur.

AURORA, ILL.—Plans are being prepared for an electric light plant to be erected by the Fox River Light, Heat & Power Company.

CERROGORDO, ILL.—A company composed of M. N. Mikels and W. M. Rader, will construct an electric light plant at a probable cost of $8,000.

CHICAGO, ILL.—The Chicago Street Lighting Company has been incorporated with a capital stock of $25,000 by A. J. Hirsch, F. W. Bigelow and A. J. C. Timm.

NEWPORT, KY.—It is proposed to establish a municipal electric light plant here, the City Council having provided a fund of $10,000 per year for the purpose.

NEW ORLEANS, LA.—The Consumers' Electric Company has applied for an electric light franchise in this city.

FRYEBURG, ME.—The Fryeburg Electric Light Company has been incorporated with a capital of $10,000. Henry B. Cotton, Conway, N. H., and A. R. Jenness, of Fryeburg, are among the incorporators.

AUGUSTA, ME.—The Columbus Electric Company has been organized at Portland with a capital stock of $1,250,000. The promoters are Gardner Rogers, Brookline; Henry R. Hayes, Dedham; John W. Hallowell, Medford; Ardon W. Coombs, Charles H. Tolman, Portland. Ardon W. Coombs is president, and Gardner Rogers is treasurer.

MANSFIELD, MASS.—It is proposed to organize the Mansfield Gas & Electric Company. F. M. Cobb and Chas. C. Hagerty are reported interested.

MIDDLEBORO, MASS.—The report of Manager George A. Philbrook of the town municipal lighting plant shows sales for the past year of $13,102.33, receipts of $23,958.76 and expenditures of $23,943.05, cash on hand, $15.71. The increase of sales for the year were $415.48. The sales of electric light were $8,233.91; gas, $3,091.99; jobbing, $1,776.43. This makes the cost of the street lighting $10,840.62.

MORRICE, MICH.—The Shiawassee Light & Power Company contemplates extending its service to Morrice, a distance of nine miles.

PLYMOUTH, MICH.—At the spring election the citizens will vote on the question of issuing $12,000 bonds for an electric light plant.

BENTON HARBOR, MICH.—The City Council has appointed a committee to investigate the question of constructing a municipal electric light plant.

BESSEMER, MICH.—E. D. Nelson, president of the Ironwood & Hurley Electric Railway, is said to be interested in a movement to harness the water power on Black River and construct an electric plant.

FERTILE, MINN.—The citizens have voted to construct an electric light plant, to be operated in connection with the water works.

SARDIS, MISS.—The council has granted D. L. Rush, of Batesville, Miss., an electric light franchise here.

NATCHEZ, MISS.—T. McClelland, president of the Jackson Bank, is reported interested in the construction of an electric light plant in Jackson, to cost about $20,000.

SPRINGFIELD, MO.—It is reported that the Springfield Lighting Company will expend about $150,000 in improvements during the year.

ST. JOSEPH, MO.—About $25,000 will be expended this spring by the St. Joseph Railway, Light & Power Co. in improving its lighting system.

BIG TIMBER, MONT.—The Council has granted a franchise to the Big Timber Electric Company.

BROCKPORT, N. Y.—It is reported that the Brockport Electric Company will be purchased by the Albion Power Company.

PLATTSBURGH, N. Y.—It is stated the Delaware & Hudson Railway Company is to install an electric light plant at Plattsburgh.

LUMBERTON, N. C.—The Council is reported to have under consideration the question of establishing an electric light plant.

HIGH POINT, N. C.—The High Point Electric Power Company has been incorporated with a capital of $20,000 by A. N. Richardson and W. S. Thomas.

SPRINGFIELD, OHIO.—The Citizens' Light, Heat & Power Company has been granted a franchise in Springfield.

LOUISVILLE, OHIO.—It is proposed to have the town lighted with electricity by some corporation. Canton, which is about seven miles distant, will likely get the contract.

CAMBRIDGE SPRINGS, PA.—The Council has granted W. B. Ross a franchise to establish an electric light plant.

LAWRENCEBURG, TENN.—It is reported that an electric light plant and water works will be constructed here.

NASHVILLE, TENN.—The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, is reported to have secured the contract for an engine and generator for the electric light plant, at $5,615.

DENISON, TEX.—The Denison Light & Power Company will erect an electric plant to cost about $40,000.

BROWNWOOD, TEX.—The Bayson Light & Power Company has been incorporated with a capital of $30,000.

FT. WORTH, TEX.—The Traders' Investment Company has secured a franchise for an electric light and power plant.

PILOT POINT, TEX.—A company has been organized here, to construct an electric light plant and ice factory. J. E. Light, president; A. W. Walker, secretary.

BRIGHAM, UTAH.—The Council is reported to have placed contracts with the General Electric Company, of Schenectady, N. Y., for a 450-hp dynamo, and with the Pelton Water Wheel Company for an 800-hp water wheel.

RENSENS, VA.—Geo. O. Tenny is stated to have secured the contract for an electric power plant at Rensens, for the Lynchburg Water Power Company, of Lynchburg. The contract price is reported to be about $100,000. This does not include the electrical equipment, which will cost an additional $75,000.

OROVILLE, WASH.—J. M. Hagerty is examining the water power on Similkameen River, six miles from Oroville, which he proposes developing for electrical purposes.

ORTING, WASH.—The Pierce Improvement Company has placed an order for machinery of a capacity of 30,000 horse-power for its electric plant to be built on the Puyallup River.

ABERDEEN, WASH.—The Gray's Harbor Power & Light Company has been organized, with a capital of $250,000, by John L. Wilson and E. C. Finch, of Aberdeen. Power for running the plant will be obtained from Little North River Falls.

MADISON, WIS.—Plans are being prepared for the municipal central power and lighting plant.

KENOSHA, WIS.—Fire in the power house of the Kenosha Gas and Power plant recently destroyed the building. The damage to machinery, etc., will be from $8,000 to $10,000.

DE PERE, WIS.—The directors of the De Pere Electric Light & Power Company have elected the following named officers: president, J. P. Dousman; vice-president, R. J. McGeehan; secretary and treasurer, L. Minich; manager, C. G. Wilcox.

HAMILTON, ONT.—The Hamilton Cataract, Power, Light & Traction Company has been incorporated with a capital of $5,000,000 by J. M. Gibson and J. R. Moodie, of Hamilton, and J. A. Kammerer, of Toronto.

THE ELECTRIC RAILWAY.

ST. AUGUSTINE, FLA.—The St. Augustine & South Beach Railway has been sold under foreclosure to Judge J. W. Henderson and Dr. Horace Lindsley. It is said that the new owners plan to reconstruct the property and equip the line with electricity.

NEW HARMONY, IND.—The Mt. Vernon, New Harmony & Northeastern Traction Company is to be incorporated. Harry Kurtz is interested.

INDIANAPOLIS, IND.—The Indianapolis & Cincinnati Traction Company has been incorporated with a capital of $1,500,000 by Chas. L. Henry, W. L. Taylor and others.

WABASH, IND.—It is announced that the Wabash River Traction Company has sold its line from Wabash to Logansport to the Union Traction Company, of Indiana. The consideration is reported to be almost $1,000,000.

FT. WAYNE, IND.—The International Construction Company, of New York, is preparing for the construction of the Goshen & Indiana Railway. The project has financed and many of the contracts for material placed.

WARSAW, IND.—The Huntington & Winona Traction Company has secured nearly all the right of way for its line from Huntington to Winona by way of South Whitely. Construction work will start in the spring.

LOUISVILLE, KY.—The Louisville & Interurban Railroad Company has been organized with $500,000 capital stock by the officials of the Louisville Railway Company. It is the intention to build a road from Louisville through the counties of Jefferson, Oldham, Shelby, Spencer, Nelson and Bullitt.

ROCKLAND, ME.—The State Railroad Commissioners have approved the location of the Rockland, South Thomaston & Owl's Head Street Railway. The proposed line will be about 8 miles in length.

CUMBERLAND, MD.—The Cumberland Narrows Electric Railway Company has been incorporated with a capital of $20,000. Judge R. H. Koch, of Pottsville, Pa., is one of the incorporators.

SHARON, MASS.—The Norwood, Canton & Sharon Street Railway Company has petitioned the Sharon, Mass., Board of Selectmen for an extension of its track to the Foxboro, Mass., line, and the selectmen have designated Saturday, Feb. 21, for a hearing.

JACKSON, MICH.—The power house of the Jackson Electric Light & Power Company was obliged to close down recently through inability to secure fuel of any kind. The service was resumed after several interruptions.

LANSING, MICH.—The city council has revoked the franchise of the Lansing City Railway Company and the police stopped the running of the cars. The company will go into court to regain possession of its franchise rights.

OMAHA, NEB.—The Omaha, Decatur & Northern Railway Company, capital $1,000,000, has filed articles of incorporation with the Secretary of State. The company intends to build an electric railway through the counties of Douglas, Washington, Burt, Thurston and Dakota.

ALBANY, N. Y.—The Hudson Valley Railway Company has changed its principal office from Waterford to Glens Falls.

JOHNSTOWN, N. Y.—The Fonda, Johnstown and Gloversville Railroad Company has increased its capital from $1,950,000 to $2,500,000.

NEW YORK, N. Y.—New York and Long Island Traction Company (formerly Mineola, Hempstead and Freeport Traction Company) has increased its capital from $125,000 to $1,000,000.

OSWEGO, N. Y.—The Rapid Transit Railway Company, of Syracuse, is reported to be considering the proposition to develop the water power at High Dam. C. F. Stenly is chief engineer.

NEW YORK, N. Y.—In accordance with the request of the State Railroad Commission the Manhattan Railway Company has added several trains to its service on the elevated roads. The new schedule calls for 97 more trips on the Sixth Ave. line and 76 on the Ninth Ave. line. Five new express trains were added to the Ninth Ave. service.

NEW YORK, N. Y.—Two experimental cars, one of which has been built by the General Electric Company and the other by the Westinghouse Company, are being tested nightly on the Ninth Avenue elevated railroad by the officers of the Interborough Rapid Transit Company. Each car is supplied with two motors of 200-hp and the tests already made show that an average speed of 45 miles an hour can be maintained.

NEW YORK, N. Y.—A franchise has been granted to the New York Interborough Railway Company by the Board of Estimate and Apportionment for the operation of a trolley road in the Bronx. The franchise is for a term of fifty years and gives the railroad company the right to run cars across Macomb's Dam Bridge and other Harlem River structures and contains the provision that at the expiration of the franchise the city can purchase the plant necessary for the operation of the road at a fair price, to be fixed by the Board of Estimate and Apportionment.

NEW YORK, N. Y.—The Metropolitan Street Railway Company will make several changes in the motive power of various branches before Nov. 1 next. Three cross-town lines are to have the electric underground system. The first change is to be on the Grand Street cross-town line. The change of the motive power is to be begun on March 20. The next change is to be on the Fourteenth Street cross-town line, which is to have the electric system. The third is to be on the Eighty-sixth Street cross-town line. It is the purpose of the company to install electricity as far as Central Park West, with the idea of running the cars through West Eighty-sixth Street some time in the future. The opposition on the part of the residents of West Eighty-sixth Street at present prevents the continuation of the line on that street.

LANCASTER, OHIO.—The Lancaster Traction Company will double track its road on Main Street and make other improvements. F. E. Ginn, Lancaster, is superintendent.

DAYTON, OHIO.—The Covington, Bradford & Versailles Traction Company has been incorporated by Dennis Dwyer, Albert Emanuel, B. M. Hopkins, E. C. Spring and T. H. Robinson.

CINCINNATI, OHIO.—J. G. Schmidtlapp, B. W. Campbell and H. A. Perkins, prominent business men of this city, are at the head of a project to build an electric railway from Decatur to Springfield, Ill.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway will erect three new sub-stations; one near Urbana, one at Springfield and the third at Dayton. The Columbus, London & Springfield Railway is also planning to increase its power facilities by erecting additional sub-stations.

MANSFIELD, OHIO.—The Citizens' Electric Railway, Light & Power Company has elected these officers: N. S. Ford, president; C. F. Ackerman, vice-president; S. G. Cummings, secretary, and Reid Carpenter, treasurer. These with T. R. Barnes, Rush Taggert, Fred R. Bristor, C. H. Voegele and Robert Hancock are directors.

ASHLAND, OHIO.—H. B. Camp, chief owner of the Ashland & Wooster Railway, a short steam road operating in Ashland and Champaign Counties, announces that the road is to be extended to Lake Erie, terminating at Huron or Vermillion. It is the intention to operate freight trains by steam and equip the line for electric passenger service.

CINCINNATI, OHIO.—Senator Roudebush, promoter of the Cincinnati, Milford & Eastern Railway Company, announces that the financing of the project has been arranged for. It is stated that the deal was put through entirely by Cincinnati and Cleveland capitalists. F. L. Fuller & Company, Cleveland bankers, are interested in the enterprise.

DAYTON, OHIO.—The Dayton & Kenton Traction Company has elected officers as follows: E. M. Hopkins, New York, president; W. W. Chambers, Dayton, vice-president; H. S. Forgy, New Carlisle, secretary; C. H. Pomeroy, Saginaw, Mich., treasurer. W. E. Harris, of De Graff, with the officers, are the directors. The power house will be located at De Graff.

DAYTON, OHIO.—Dr. Samuel F. George, president and chief promoter of the Cincinnati, Dayton & Ft. Wayne Traction Company, announces that his project has been financed and that actual construction work is to start early in the spring. The project contemplates the building of a system of electric lines touching Cincinnati, Dayton, Ft. Wayne, Toledo and other cities.

TOLEDO, OHIO.—At the recent annual meeting of the Toledo Railways & Light Company the following named directors were elected: H. A. Everett, L. E. Beilstein, Albion E. Lang, E. W. Moore, Robert Van Courtlandt, of New York; Herbert S. Holt, of Montreal, and Barton Smith, of Toledo. Mr. Lang was chosen chairman of the board, Mr. Everett president, Mr. Beilstein vice-president and general manager, E. O. Reed secretary, and S. D. Carr treasurer.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Electric Railway Company has elected officers as follows: P. McCrary, president; F. E. Flory, vice-president; D. H. James, secretary; H. R. Klauser, treasurer; A. E. Klauser, Hugh Schunk, Theodore Schmidt and H. S. Landis directors. The company increased its capital stock from $10,000 to $1,800,000. It also let the contract for building the road to the Cooper Construction Company, of Toledo.

CLEVELAND, OHIO.—The incorporation of the Mansfield, Crestline & Galion Railway, with a nominal capital of $10,000, was the preliminary step of the merging of the new line between Mansfield, Crestline and Galion with the Ohio Central Traction Company. Nominally it has been a part of that line since it was completed some weeks ago. The new company will continue the name of the Ohio Central Traction Company and will have a capital stock of $700,000. When the Wellington-Mansfield line is completed, the whole will be absorbed by the Cleveland & Southwestern Traction Company. All the roads mentioned are Pomeroy-Mandelbaum properties.

WHEELING, W. VA.—The Wheeling Traction Company has secured the necessary consents for the construction of a line over an entirely new route into this city. The route will provide a favorable entry for the proposed interurban line to Steubenville.

SOUTH PARKERSBURG, W. VA.—The promoters of the South Parkersburg Electric Railway Company, which will build a line in Wood County, have also incorporated the South Parkersburg Light, Power & Water Company, capital stock. The plan is to build a large plant to supply the railway as well as to furnish city lighting and other utilities. W. G. Peterkin, John Moss, H. P. Camden and G. L. Fries are interested.

MILWAUKEE, WIS.—For a consideration of $3,400,000, subject to a bond issue of $1,500,000, the Chicago & Milwaukee Electric Railway Company has transferred its right of way and property to the Chicago & Milwaukee Electric Railroad Company. The ultimate completion of the electric line between Milwaukee and Chicago will warrant the bond issue.

TORONTO, ONT.—The shareholders of the Toronto Street Railway Company have re-elected the former officers. The gross earnings of the railway for the year were $1,834,908, an increase of $173,890 over last year. The net profit was $506,442. There were 44,437,678 passengers carried, being an increase of 4,589,591 over last year.

ST. JOHN, N. B.—The St. John Street Railway Company is preparing to greatly improve and extend its street car service in the city. The company carries on not only the street railway, but also all gas and electric lighting business of St. John, and has a very valuable franchise. Large improvements are to be made to the power houses, and heavy generators are to be installed.

NEW INDUSTRIAL COMPANIES.

THE O'BRIEN ELECTRICAL COMPANY, of Monterey, Calif., has been incorporated, with a capital stock of $25,000, to deal in electrical appliances.

THE NEW JERSEY ELECTRO-THERAPEUTIC SANATORIUM COMPANY has been incorporated with a capital of $100,000 by Dr. F. K. Irving, C. H. Bunn and John J. Berry.

THE EASTERN ELECTRIC CONTRACT COMPANY, of Jersey City, N. J., has been incorporated. Capital, $100,000. Incorporators: Chas. N. King, W. H. Greene and Le Grand Bouker.

THE CARROLLTON ELECTRIC COMPANY, domiciled at Carrollton, La., has been incorporated by C. B. Clower, J. M. Phillips and John Martin. Capital stock, $10,000.

THE RAILWAY ELECTRICAL IMPROVEMENT COMPANY has been incorporated in Jersey City, N. J., by Ernest P. Haas, Jesse K. Whittaker and Kenneth K. McLaren. The capital is $50,000.

THE PEERLESS TELEPHONE MFG. COMPANY has been incorporated at Rio, Wis., with a capital stock of $10,000. The incorporators are J. L. Farington, Chas. Caldwell and David Robertson.

THE STAR DYNAMO COMPANY, of Jefferson City, Mo., has been incorporated, with a capital stock of $5,000, all paid. The incorporators are Wm. A. Magee, John M. Dutro and Samuel T. Rowley.

S. EDWARD EATON & CO., have organized at Nyack, N. Y., to do electrical and mechanical engineering. The capital stock is $50,000 and the directors are W. A. Eaton and J. S. Eaton, of Nyack, and E. B. Statt, of Brooklyn.

THE WARREN SELECTIVE TELEPHONE SWITCH COMPANY, of Sheldon, Mo., has been incorporated to manufacture telephone apparatus; capital stock, $10,000. Incorporators: John A. Warrick, A. J. Warrick and Semer Cobb.

THE TAYLOR ELECTRIC TRUCK COMPANY, of Troy, N. Y., has been incorporated to manufacture railway and steel car trucks, wheels and car brakes; capital, $75,000. Directors: William F. Gurley, John Taylor and A. Louise Gurley, of Troy.

THE MISSOURI AMERICAN ELECTRIC COMPANY, of St. Louis, has incorporated with a capital stock of $20,000. The shareholders are R. F. Plochman, O. E. Plochman, A. W. W. Miller, George P. McDonnell, L. V. Reach, Ernest Mueller, E. E. Dougherty, Harold R. Small, Harry C. Barker.

THE SHEFFIELD COMPANY, of Tuscumbia, Ala., has been incorporated in New Jersey with a capital of $425,000. The company will acquire the electric light franchise and franchises for a trolley line in Tuscumbia and Florence and the water works of Sheffield. Geo. Parsons, of New York, N. Y., and Col. A. B. Andrews, of Raleigh, N. C., are reported interested.

THE WILLYOUNG & GIBSON COMPANY was incorporated Feb. 6 with the following officers: Elmer G. Willyoung, president and general manager; C. R. Gibson, secretary and treasurer, under the laws of the State of New York, with a paid-up capital of $25,000. The corporation has taken over the business formerly conducted under the title of Elmer G. Willyoung, and will immediately expand the facilities. It is the intention to cover the entire field of high-class scientific instruments and also to make a separate department for electro-therapeutic and allied surgical appliances for the medical profession. The prospects of this combination are very bright; the business last year having exceeded by considerably over fifty per cent. that done during the preceding year. Mr. Willyoung is already well known to the electrical profession. It is Mr. Gibson's first connection with the electrical industry.

THE AUTOMOBILE.

INDIANAPOLIS AUTOMOBILE SHOW.—The annual automobile show will be held in Indianapolis, Ind., the first week in April. Interesting events are being arranged and the entries are very promising.

LEGAL.

TELEPHONE COMPANY ENJOINED.—Judge Windes, at Chicago, on behalf of the Appellate Court, has affirmed the order entered in Judge Tuley's court a year ago granting a temporary injunction to restrain the Chicago Telephone Company from charging more than the franchise rate of $125 a year for its business service. The restraining order also enjoined the company from removing the telephone appliances from the complainants' places of business and from cutting off their service. The suit was brought by the Illinois Manufacturers' Association, and several hundred business men and firms joined in the bill as co-complainants.

PERSONAL.

COL. H. G. PROUT.

COL. HENRY G. PROUT has been appointed vice-president of the Union Switch & Signal Company, of Swissvale, Pa., and the Westinghouse industrial forces thus enjoy the accession of a notable leader. He is of English-Devonshire descent, fought at the front as a youth in one of the Massachusetts regiments during the Civil War, and then completed his education at the University of Michigan, where he graduated with the degree of civil engineer. After engaging in the practice of his profession in railroad surveys through the Rockies, he entered the service of the Khedive of Egypt as a major of engineers, and soon became an intimate associate and friend of General "Chinese" Gordon. Major Prout was sent to the head of the Nile as Governor-General of the Province of the Equator, where he had 3,000 soldiers under him and was supreme in finance, civil and military affairs. When he retired as Baroud Bey he was offered the rank of Pasha and the governorship of either of two Egyptian provinces to stay. Had the Suakim-Nile railroad that he recommended been built, Gordon would not have perished, and the Soudan would not have been lost. Returning to America, Col. Prout became signal engineer for the Union Switch and Signal Company, and in 1887 he was made editor of the *Railroad Gazette*. He remained with that admirable engineering publication for 15 years and has left a deep imprint on its pages and policy. This editorial work has been supplemented by a great variety of professional engagements. He has given lectures in nearly all of the engineering schools from Boston to the Mississippi, is departmental editor for the railroad division of the new volumes of the Encyclopedia Britannica, and he has done a good deal of writing for the magazines and the daily press. Few editors of class journals have become more widely known personally, and in 1902 his work as an editor was recognized by Yale University in the honorary degree of Master of Arts. He has been a member of the American Society of Civil Engineers for many years, has served that society as a director and on several special committees, and is now on the committee to consider the question of a revision of the standard rail sections. He is serving his third term as vice-president of the Engineers' Club of New York, and is one of the governors. He is a member of the American Railway Engineers and Maintenance of Way Association, of the Master Car Builders' Association, of several Railroad Clubs, a Corresponding Member of the American Geographical Society and a member of the Century Club, of New York, being now on its Admissions Committee. His most recent notable appearance was as presiding officer at the banquet to signalize the foundation of the John Fritz gold medal by the four national engineering societies.

MR. G. MARCONI had the honor of being received by King Edward at Buckingham Palace on February 13.

DYER & DYER is the new name of the well-known patent law firm of Dyer, Edmonds & Dyer, of New York City.

MR. W. B. RANKINE, of the Niagara Falls electric power interests, has been elected a director in the Equitable Trust Company of New York City.

MR. R. E. GALLAHER, the general manager of the New York Insulated Wire Company, is mitigating the terrors of the winter by a sojourn at St. Augustine, Fla.

MR. ALAN D. KENYON, of the law firm of Kenyon & Kenyon, actively engaged in so many electrical litigations, has returned to New York from a trip taken to Bermuda in successful search for health.

MR. DANIEL SKELTON has been appointed superintendent of the American District Telegraph Co., of New York. He has risen by merit, having entered the service of the company as a messenger in 1876.

MR. GARDINER C. SIMS has been appointed a police commissioner for Providence, R. I. This will give him a splendid chance to try in a new field his proved expertness in governing engines and dynamos.

MR. M. H. GERRY, JR., of Helena, Mont., has become associated with the Great Northern Power Company, of Duluth, Minn., in the capacity of consulting electrical engineer during the construction of the company's power plant.

MR. CHARLES DAY, of the firm of Dodge & Day, modernizing engineers of Philadelphia, read a paper before the last meeting of the Westinghouse Electric Club, of Pittsburgh, on "Recent Developments in Machine Tool Equipment."

MR. MAX LOEWENTHAL, who has done some excellent electrical engineering work for the Prometheus Electric Company has been appointed secretary of that concern, in which other important progressive changes have been made lately.

MR. CALVIN W. RICE was, last month, elected a member of the Institution of Electrical Engineers of London, having been proposed by Lord Kelvin. At the last meeting of the M. I. T. Alumni Association of Western Pennslyvania, Mr. Rice was made president.

PROF. A. B. PORTER.—The editors of this journal would like to get the address of this gentleman, for whom they hold a volume of Prof. S. P. Thompson's translation of Gilbert's "De Magnete." The copy has been sent to the Armour Institute, Chicago, and one other address without success.

MR. GEORGE H. MORGENSTERN resigned his position recently as manager of the sales department of the pay station consolidation, controlled by the Baird Manufacturing Company, and has accepted a position as manager of the sales department of the Vought-Berger Company, La Crosse, Wis.

MR. T. A. EDISON, according to a New York *Sun* reporter, says he is going to take a two years' vacation from industrial work and devote the holiday to the scientific investigation of recondite phenomena of which he has been making copious notes for years past in a big volume of 400 pages.

MR. CHARLES WIRT has been granted the John Scott medal of the Franklin Institute of Philadelphia for his improvements in electrical apparatus of the rheostat type, and particularly that the essential feature of which comprises a flat, jointless ribbon winding made usually with a continuous taper or graduation in ampere capacity.

MR. P. M. TAYLOR has been elected manager of the Dickinson Hard Rubber Company, Springfield, Mass., succeeding Carl F. Siemon. The concern is now turning out a high grade of insulating material in the shape of cross bars, bushings, keys, telephone receiver shells, plugs, mouthpieces, etc. Mr. Taylor remains the treasurer of the company.

MR. CESARE PIO, of Milan, Italy, has recently been appointed agent in that country for the American electrical apparatus, the sale of which is controlled there by the Goudey-McLean Co., of New York, including Milwaukee electric apparatus, Keystone instruments, Garton-Daniels lightning arresters, Pittsburgh transformers and Fostoria incandescent lamps.

MR. W. D. SARGENT, vice-president and general manager of the New York & New Jersey Telephone Company, was given a dinner at the Hamilton Club, Brooklyn, last Saturday, February 14, by a number of personal friends and associates to celebrate his forthcoming marriage during the present week. The menu took the appropriate form of a valentine, and an original poem was read by Treasurer Snow, of the company.

MR. C. C. HINES, lately electrical engineer with the Loraine steel interests has become associated with the Canadian Pacific Railway in charge of important electric motive power work in their shops, etc., and will make his residence in the Dominion. He has great possibilities with that progressive corporation and should prove fully equal to them. Mr. Hines is a valued contributor to these pages.

MR. EDWIN H. SMYTHE, of the patent department of the Western Electric Company, Chicago, one of the early and most successful American workers in the field of wireless telegraphy, has been visiting New York the past week in regard to his interests in that field. Mr. Smythe has already patented some of his work and is still very active in seeking to promote the practicability and perfection of this promising industry.

MR. F. S. PEARSON, one of the prime movers in the Mexican Light & Power Company, 29 Broadway, is expected back from Mexico next week. It will be recalled that the Mexican company has been organized with a capital of $12,000,000 for the purpose of constructing a huge power transmission plant —initial capacity to be 40,000-hp—to furnish Mexico City and vicinity with electric energy for lighting, manufacturng and traction.

MR. A. A. CARY, the well-known mechanical engineer, has just had the great misfortune to lose his wife, the daughter of the late Capt. Stone, of Cincinnati, leader in the telephone and street railway interests of that city. Mrs. Cary, who had been in poor health for some time past, was a young woman of most charming and sympathetic personality and had a large circle of acquaintances in electrical circles. It may be noted that it was after her that her father named his famous trotter "Maud S."

PROF. A. E. DOLBEAR, of Tuft's College, at a recent dinner of the Boston Schoolmaster's Club, discussed space telegraphy, and stated that a recent message to England, sent by the Marconi system, was received at several stations in that country when it was intended for only one. He asserted that until space telegraphy is so perfected that a message can be received selectively only by the station for which it is intended, the greater part of its commercial value is missing. He also expressed his conviction that the space-telegraph experiments would teach something about the ether.

MR. W. J. WILGUS, fifth vice-president of the New York Central, made the announcement last week that the electrification of certain portions of the various routes of the company in New York City and vicinity is in charge of a commission consisting of Mr. Wilgus, Bion J. Arnold, Frank J. Sprague, George Gibbs and Arthur M. Waitt. The electrical and mechanical corps reporting to the commission is under the general charge of Edwin B. Katte, electrical engineer. The above action has already been noted briefly in these columns. Arthur J. Slade is appointed mechanical engineer, with office in New York, in charge of the designing and construction of heat, light and power plants, water and fuel supply stations, vice Edwin B. Katte.

Trade Notes.

MR. WM. ROCHE, 42 Vesey St., New York, has just issued a new catalogue wherein is set forth all the merits claimed for his various products—new Standard dry batteries, flash lights, gaslighters, spark coils, etc.

THE OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York, is sending out to the trade a very unique and attractive folder calling attention to the merits of "Flexduct." It is handsomely gotten up and is the first of a series.

THE NEW YORK SAFETY STEAM POWER COMPANY has closed a contract for two 120-hp Worthington water-tube boilers for the Majestic Hotel, New York, and a 100-hp, 11x12 engine, to be direct-connected to a 37½-kw Westinghouse generator, for J. W. Beardsley's Sons.

ELECTRIC LIGHTING OF RAILWAY CARS.—Bulletin No. 75 of the Electric Storage Battery Company, Philadelphia, is devoted to the use of storage batteries in railway car lighting. The text points out the advantages of this use of storage batteries, and five illustrations show views of railway cars electrically lighted by their means.

THE STANDARD ELECTRIC CONSTRUCTION COMPANY and the California Incandescent Lamp Company, R. J. Davis, president, have opened extensive show rooms and offices occupying the entire ground floor of one wing of the new Rialto Building on New Montgomery St., near Mission, San Francisco. The Elblight Company will have quarters at the same location.

INNER GLOBES.—The Shelby Electric Company, Shelby, Ohio, has issued a catalogue giving illustrations and dimensions of Shelby inner globes for enclosed arc lamps of all makes. Eighty-eight styles of globes are shown. The company pays particular attention to perfect grinding of its globes, which are made of the highest grade of glass.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY has issued a calendar for 1903 in which the illustration exemplifies the satisfaction that comes from using Kellogg telephones. The cut is that of a girl holding a received to the ear of a dog, and by the expression of delight on the animal's face it is evident a familiar voice is speaking. The calendar is attractive and very serviceable.

THE CENTRAL ELECTRIC CO., of Chicago, has recently published a new telephone catalogue dated February, 1903. It contains a complete line of the products manufactured by the Williams-Abbott Elec. Co., for whom the Central is sales-agent. In addition to the Williams-Abbott material, the catalogue contains a list of wires, insulators, tools, batteries and all other supplies used by telephone companies. A copy will be sent upon request.

THE NERNST LAMP COMPANY reports its western business increasing to such an extent that it is obliged now to open a Chicago office in addition to its other offices in New York, Philadelphia and Boston. The management of the office will be in the hands of Mr. A. E. Fleming, whose face is very familiar to all those who visited the Pan-American Exposition and saw the wonderful display of Nernst lamps there under the direction of Mr. Fleming.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just issued for immediate distribution a handsome conduit catalogue. It is well arranged and is probably the most complete little catalogue of its kind ever issued by a supply house. Besides illustrating the complete line of Toler system of conduit boxes it furnishes a number of working diagrams, and is full of valuable information along that line. A copy will be mailed upon application.

CROSELMIRE & ACKOR, platinum refiners, Newark, N. J., report business exceptionally brisk. This new concern is constantly increasing its business, especially in the electrical trade, although it has been in existence only a little over a year. Mr. F. A. Croselmire, the junior member of the firm, is well known to the electrical trade. This concern is sending out a very neat and attractive letter opener to its friends in the electrical trade, which will be much appreciated.

THE THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, Detroit, Mich., has secured a factory site and is now arranging for the erection of a factory for the manufacturing of wireless telegraph and telephones, and parts, as it has secured many large orders from educational institutions and others which runs into many thousands of dollars. It is also distributing among those interested, illustrated pamphlets showing some of the types of instruments that this company is manufacturing.

STORIES OF SUCCESS.—Under the title "One Thousand and One Stories of Success," the International Correspondence Schools, Scranton, Pa., have issued a booklet containing a list of names of more than one thousand students who have advanced either in salary or in position as a result of the International Correspondence Schools' training by mail. The list gives, besides the names, the place of residence of the students and particulars as to how they were benefited. The list is classified by States. The work of the schools is not limited by national boundaries; it is carried on in all civilized countries on the face of the globe, as this booklet shows.

W. M. SHEEHAN & CO., 136 Liberty St., New York, are now mailing the second issue of their descriptive catalogue and price list of Nernst lamps. The catalogue has been gotten up with considerable care and not only gives a very good description of the lamp in general, but also gives wattage tests, the distribution of light economy, as compared with standard incandescent lamps, and explains the operation of the Nernst lamp in a very concise way. Messrs. Sheehan & Co., as general distributing agents for the Nernst Lamp Co., carry a heavy stock of lamps and parts and report a steadily increasing demand for this deservedly popular form of illuminant.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has recently issued two new bulletins, Nos. 3037 and 3039. The former is devoted to the use of alternating current motors to the driving of positive pressure blowers, and the second relates to automatic start induction motors. Both subjects are comprehensively discussed and illustrated. The company has also issued three slips giving some points on the subject of Emerson motors (1) in the press room, (2) to run sewing machines and (3) in doctors' offices. The slips are intended principally for the use of agents and dealers who desire to bring to the attention of the public the convenience and advantages of using these motors in various lines of work. They are made to go into the ordinary size envelope.

MR. J. FRANCIS SHERIDAN, 1717 S. Chadwick St., Philadelphia, Pa., is about to incorporate the Anglo-American Underground Telegraph and Telephone Cable Syndicate with offices in New York and London. He has, it is said, perfected a cheap and reliable system of underground cables, with accessories, using compounds of his own invention and specially treated paper. He desires the co-operation of a reputable manufacturing concern or a few responsible investors to assist him in the incorporation of the company. Mr. Sheridan has just returned from a 4-years' sojourn in Europe where he studied the requirements of underground telephone and telegraph service.

THE AARON ELEC. CO., of Chicago, now makes a very neat line of motors from ½ to 25-hp. For the past two years the greater part of this company's energy has been devoted to manufacturing these motors to meet the unprecedented demand which has arisen during these prosperous times. These motors are the semi-enclosed type, multipolar. The frames are of cast iron, holding cast steel pole pieces. The field coils are form wound and thoroughly insulated, and are interchangeable. The brushes are the radial carbon type, with an adjustable tension on each brush, but the carbons are of such number and cross section that the full load current is about half the carrying capacity of the brush. The bearings are self-oiling, lined with phosphor bronze sleeves. The commutators are made of pure drop forged copper, with mica insulated segments. The bases are arranged so that the motor can be mounted in almost any position on either the wall, floor or ceiling.

ELECTRIC HEATING.—Under the ingenious title of "The Wireless Electric Heating System," the Prometheus Electric Company, of 60 Reade Street, New York City, has issued a handsome pamphlet describing its heating and cooking apparatus and resistances. These are beautifully illustrated with half tone cuts and the features of each piece are set forth in detail. As is known, the Prometheus heating element consists of a strip of mica on which a layer of metal has been deposited, or fired. This conducting strip is protected by another piece of mica and the whole is enclosed in a metallic casing. This unit can be painted to any desired resistance. The paint is an alloy composed of non-oxidizable metals, insuring the element's life. The element may be either straight or circular according to its usage and may be inserted into or removed from a piece of apparatus with the greatest ease in case of a break-down, thus lending itself freely to a great variety of applications large and small, industrial or domestic, etc.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 10, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

719,983. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. A storage battery on each car is charged by the main current and the current from the battery is used to operate the electro-magnetic switching devices.

719,984. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. A magnet of sufficient length to bridge two of the switching devices in the branch circuits to the working conductor, is energized by a battery on the car.

719,987. GUARD FOR SPEECH RECEIVERS OR TRANSMITTERS; S. J. Ballard, Los Angeles, Cal. App. filed July 2, 1901. (See page 324.)

719,991. ELECTRIC CONTROLLER; R. W. Brown, Chicago, Ill. App. filed Aug. 30, 1902. A series of resistance shunting switches can be operated successively or all simultaneously.

719,998. TELEPHONE SYSTEM; E. E. Clement, Philadelphia, Pa. App. filed June 4, 1901. (See page 324.)

719,999. SIGNALING APPARATUS AND SYSTEM; E. E. Clement, Philadelphia, Pa. App. filed June 13, 1901. (See page 324.)

720,004. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed March 18, 1901. When the primary impulse of a signal is transmitted, it initiates a record on a chemically prepared receiving tape; the transmitting generator is then disconnected and the formation of the record is continued by the capacity effects of the circuit.

720,020. MEDICAL BATTERY; F. Grimshaw, Northeast, Pa. App. filed July 10, 1901. Details.

720,023. ELECTRIC CABLE; R. F. Hall, New York, N. Y. App. filed March 10, 1902. A cable comprising a core made up of pairs of twisted wires, the wires forming the different pairs being held in position by a paper strip consisting of a backing and a looped separating piece.

720,024. ELECTRIC FURNACE; J. F. Hammond, New York, N. Y. App. filed Feb. 1, 1902. A furnace for the use of dentists arranged so that the work can be easily examined while being heated.

720,029. CONTROLLER FOR ELECTRIC MOTORS; O. Holz, Schenectady, N. Y. App. filed Oct. 4, 1901. A movable member for supporting the blow-out coil in close proximity to the contact finger.

720,073. ELECTRICAL FUSE-HEAD AND FUSE; N. Schmitt, Kupperstey, and Johann Krannichfeldt, Cologne, Germany. App. filed Sept. 10, 1900. A mine exploder. A strip of celluloid or other non-conducting material is coated on each face with foil or other conducting material and a priming compound molded on the end connecting the two conducting faces. The patent deals mainly with manufacturing details whereby the cost of the fuses may be made small.

720,082. MAGNETO BELL; C. H. Thordardson, Chicago, Ill. App. filed March 8, 1902. Details.

720,085. TELEPHONE-TRANSMITTER; F. S. Tucker, Boston, Mass. App. filed July 5, 1902. (See page 324.)

720,087. ELECTRIC FUSE BOX; T. Van Aller, Schenectady, N. Y. App. filed May 1, 1901. The fuse is inclosed in a chamber whose walls come in contact with parts of the fuse to keep them cool, the other parts being thus more rapidly heated. An open channel connects the parts least protected with a section of the fuse lying across a discharge opening in the path of which is a body of gravel which chills the gases and prevents the discharge of flame from the fuse box.

720,092. APPARATUS FOR MAKING COILS FOR ELECTRICAL APPARATUS; E. L. Aiken, of Schenectady, N. Y. App. filed Dec. 5, 1898. A process for making spiral coils of small number of turns, but large cross section. A rod, strip or bar is wound about a mandrel while at a temperature below that of the softening point of the metal, the pitch being determined by a guide.

720,093. COIL FOR ELECTRICAL APPARATUS; E. L. Aiken, Schenectady, N. Y. App. filed Dec. 5, 1898. A conductor of large cross section is wound into a few turns which are separated by the slightest possible air space.

720,095. AUTOMATIC REGULATOR FOR X-RAY TUBES; W. S. Andrews, Schenectady, N. Y. App. filed June 5, 1897. An electric heater for vacuum tubes comprising a number of conductors in series, insulated from each other and supported by an electrical insulator adapted to transmit heat to the tube.

720,103. TELEPHONE-PROTECTING DEVICE; G. R. Bonham, Empire Prairie, Mo. App. filed May 6, 1902. (See page 324.)

720,307. ARMATURE BAND; J. J. Wood, Fort Wayne, Ind. App. filed Feb. 26, 1902. An improved fastening device for the meeting ends of the strap.

720,312. ELECTRIC ARC LAMP; H. Baggett, London, Eng. App. filed Nov. 22, 1902. Details.

720,321. SECONDARY BATTERY; F. Buchanan, Dayton, Ohio. App. filed March 18, 1901. The outer containing cell constitutes the negative electrode; an inner cell is both a positive and a negative electrode, while a positive electrode occupies the central position, thus giving a substantially four-volt battery.

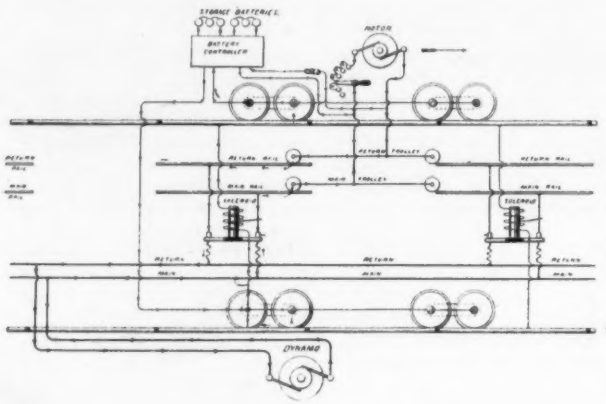
720,326. PROCESS OF PREPARING STORAGE BATTERY PLATES; R. N. Chamberlain, New York, N. Y. App. filed March 3, 1899. The plates are exposed successively to electrolytic action as anodes in a solution capable of dissolving lead, thereby cleaning and roughening the plate.

720,327. ELECTRIC SWITCH; R. N. Chamberlain, Depew, N. Y. App. filed April 16, 1902. A dynamo electric counter-electromotive force generator is included in shunt with the end-cell of a storage battery at the moment the latter is being cut in or out, to prevent short-circuiting of the end cell.

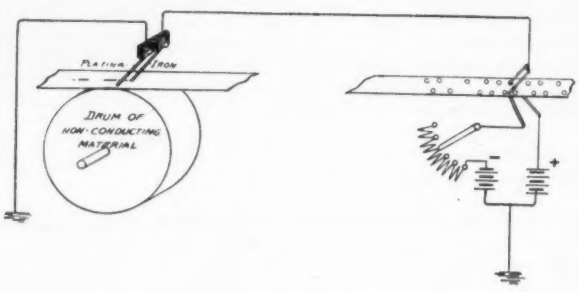
720,333. TROLLEY AND BRAKE FOR AERIAL RAILWAYS; M. J. Doner, St. Louis, Mo. App. filed Aug. 18, 1902. A rod is connected to both the trolley arm and a brake lever, so that the brakes are applied when the arm is lowered.

720,335. MEANS FOR MEASURING ELECTRIC CURRENTS; G. N. Eastman, Chicago, Ill. App. filed June 20, 1902. A high resistance shunt conductor is wound non-inductively around the conductor carrying the current to be measured and includes a potential-indicating instrument.

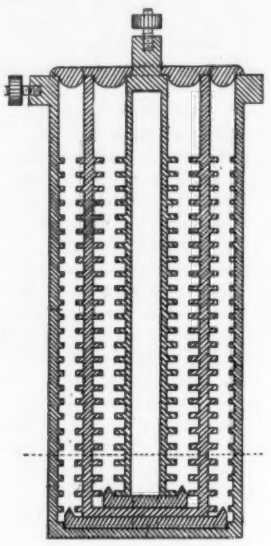
720,347. FIRE AND POLICE ALARM CALL SYSTEM; W. J. Hofstatter, Toledo, Ohio. App. filed Jan. 31, 1902. Details.



719,983.—Electric Railway.



720,004.—Telegraphy.



720,321.—Secondary Battery.

720,152. COMMUTATOR METER; J. F. Kelly, Pittsfield, Mass. App. filed Oct. 19, 1901. Means for preventing sparking or burning at the commutator.

720,156. MAGNETIC SEPARATOR; J. Kirschweng, Butte, Mont. App. filed Aug. 17, 1901. An automatic alarm to indicate the choking of the ore-chute.

720,184. INSULATOR; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 28, 1900. An insulator adapted to be set into the web of an iron beam and provided with means for locking it in place.

720,186. APPARATUS FOR ELECTRO-ENDOSMOTICALLY FREEING MATERIALS FROM FLUIDS; B. Schwerin, Berlin, Germany. App. filed April 24, 1902. The body of liquid undergoing treatment is divided up into a number of thin layers to facilitate the process.

720,226. LIGHTNING ARRESTER; J. P. Coleman, Edgewood Park, Pa. App. filed Feb. 1, 1902. The discharge plates are arranged so that the discharges are permitted to occur between any two plates of a group representing two circuits, while only one air gap is presented to the path of rupture.

720,233. RECEIVING TAPE FOR CHEMICAL TELEGRAPHS; P. B. Delany, South Orange, N. J. App. filed May 29, 1902. The tape is corrugated before it is rolled into a coil, so that it may be rolled under tension and will absorb the sensitizing chemical without bursting.

720,235. PROCESS OF RECOVERING AND SEPARATING METALS FROM THEIR ORES; H. A. Frasch, Hamilton, Canada. App. filed Nov. 2, 1900. The body containing the metals to be extracted is utilized as the anode in the bath.

720,273. ELECTRIC RAILWAY; T. E. Murray and J. Van Vleck, New York, N. Y. App. filed Nov. 22, 1901. An automatic railway in which the cars switch themselves onto their proper sidings at stations, the current being cut off and the brakes applied at the proper time.

720,305. CURRENT REGULATOR; J. J. Wood, Fort Wayne, Ind. App. filed Dec. 14, 1901. Consists of a coil and a core, one movable relative to the other, the core having approaching poles to reduce and localize the air gap.

720,350. SYSTEM OF DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. App. filed Dec. 17, 1901. (See Current News and Notes.)

720,351. SYSTEM OF DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. App. filed Jan. 14, 1902. (See Current News and Notes.)

720,352. SELF-REGULATED SYSTEM OF ELECTRICAL DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. (See Current News and Notes.)

720,369. MANDREL FOR CONDUIT SECTIONS; R. W. Lyle, New York, N. Y. App. filed Oct. 17, 1902. The mandrel has a spiral scraping wing and is adapted to be drawn through the conduit as the sections thereof are laid, to line them up and clean them of mortar, etc.

720,454. GUIDE WHEEL AND GUIDE; A. H. Mathesius, Brooklyn, N. Y. App. filed March 26, 1900. The wheel has a tread capable of revolving independent of its flanges, so that wear upon the cable will not be caused by unequal peripheral speeds.

720,475. CLIP FOR ELECTRICAL KNIFE SWITCHES; C. D. Platt, Bridgeport, Conn. App. filed Dec. 9, 1902. A pair of plates riveted together at their middle and having at one end parts to receive the knife blade and at the other end angular jaws to embrace an angular block for the wire connection.

720,483. ELECTROMEDICAL APPARATUS; G. S. Rider, New York, N. Y. App. filed April 17, 1902. Details.

720,508. ELECTRICAL SHIP'S-LOG APPARATUS; T. F. Walker and T. S. Walker, Birmingham, England. App. filed Jan. 25, 1902. A registering taffrail log which by means of electrical contacts may control one or more distant registers. The motion of the rotator in the water rotates a pinion in the register geared with an arbor having a tensional spring. Each revolution this latter is tripped, and in course of returning to its initial position a momentary electrical contact is made.

720,511. DRUM ARMATURE; H. A. Balcome, Jamaica Plain, Mass. App. filed April 23, 1902. The winding consists of flexible coils of equal length stretched over the core in the same direction, the ends of each coil passing over a number of coils and under an equal number of coils and being stretched taut to lie snugly against the core and underlying coils.